SOIL SURVEY OF

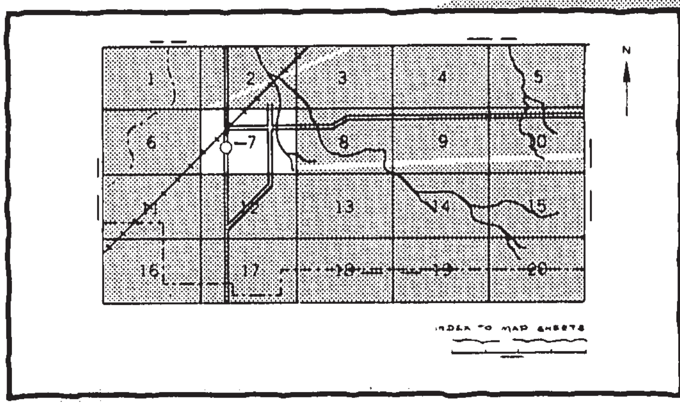
YUMA-WELLTON AREA

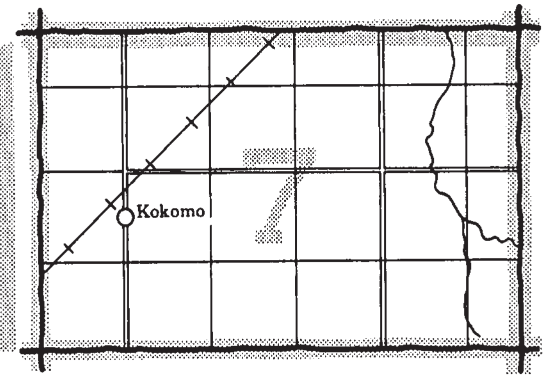
PARTS OF YUMA COUNTY, ARIZONA, and IMPERIAL COUNTY, CALIFORNIA

United States Department of Agriculture
Soil Conservation Service
in cooperation with the
Arizona Agricultural Experiment Station and the
California Agricultural Experiment Station

HOW TO USE

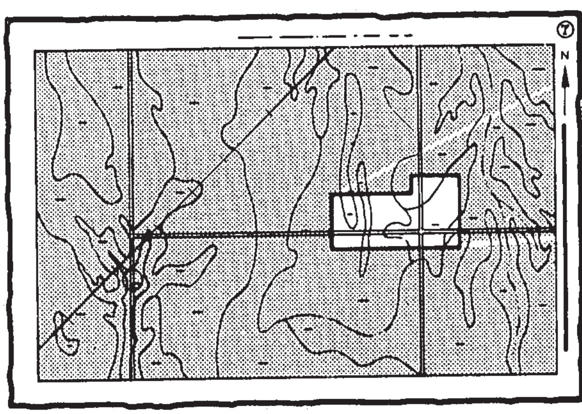
1. Locate your area of interest on the "Index to Map Sheets" (the last page of this publication).

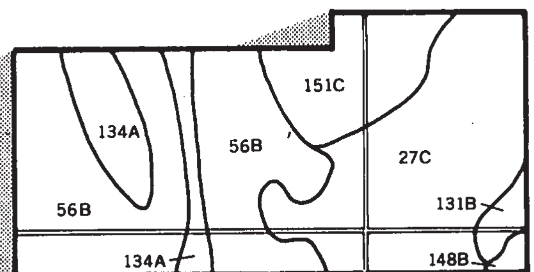




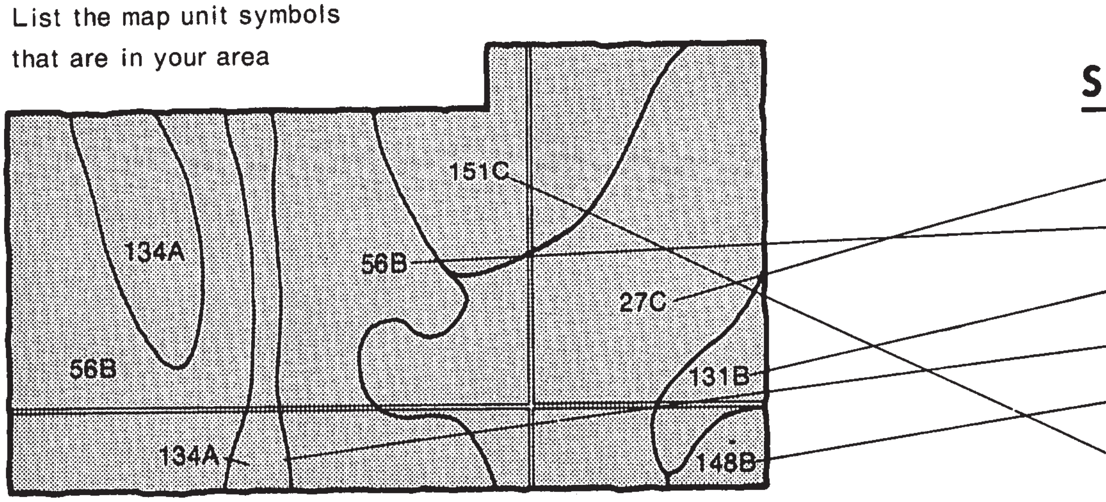
2. Note the number of the map sheet and turn to that sheet.

3. Locate your area of interest on the map sheet.





4. List the map unit symbols that are in your area

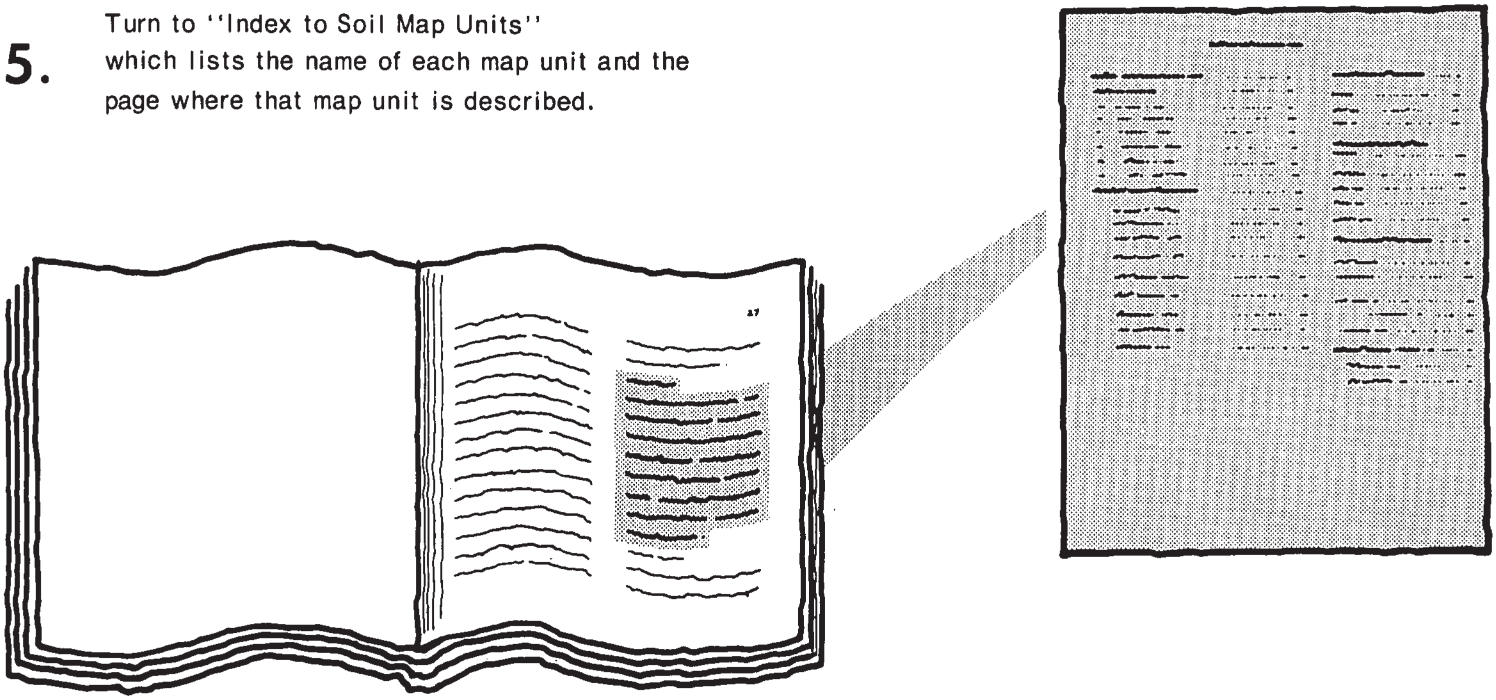


Symbols

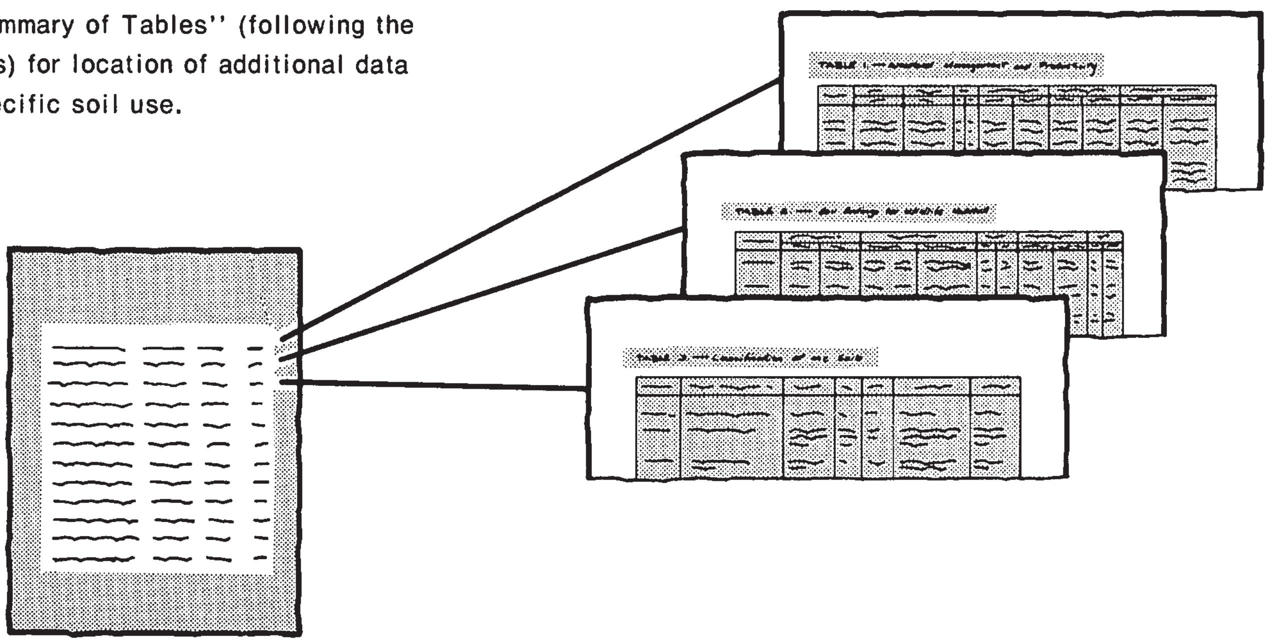
27C
56B
131B
134A
148B
151C

THIS SOIL SURVEY

5. Turn to ''Index to Soil Map Units'' which lists the name of each map unit and the page where that map unit is described.



6. See ''Summary of Tables'' (following the Contents) for location of additional data on a specific soil use.



7. Consult ''Contents'' for parts of the publication that will meet your specific needs. This survey contains useful information for farmers or ranchers, foresters or agronomists; for planners, community decision makers, engineers, developers, builders, or homebuyers; for conservationists, recreationists, teachers, or students; for specialists in wildlife management, waste disposal, or pollution control.

This is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and agencies of the States, usually the Agricultural Experiment Stations. In some surveys, other Federal and local agencies also contribute. The Soil Conservation Service has leadership for the Federal part of the National Cooperative Soil Survey. In line with Department of Agriculture policies, benefits of this program are available to all, regardless of race, color, national origin, sex, religion, marital status, or age.

Major fieldwork for this soil survey was completed in the period 1972-77. Soil names and descriptions were approved in 1978. Unless otherwise indicated, statements in the publication refer to conditions in the survey area in 1978. This survey was made cooperatively by the Soil Conservation Service, the Arizona Agricultural Experiment Station, and the California Agricultural Experiment Station. It is part of the technical assistance furnished to the Laguna, Yuma, and Wellton-Mohawk Valley Natural Resource Conservation Districts and the Bard Resource Conservation District.

Soil maps in this survey may be copied without permission, but any enlargement of these maps can cause misunderstanding of the detail of mapping and result in erroneous interpretations. Enlarged maps do not show small areas of contrasting soils that could have been shown at a larger mapping scale.

Cover: Typical landscape in the Yuma-Wellton Area.

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Issued December 1980

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Foreword

The Soil Survey of Yuma-Wellton Area, Parts of Yuma County, Arizona, and Imperial County, California, contains much information useful in any land-planning program. Of prime importance are the predictions of soil behavior for selected land uses. Also highlighted are limitations or hazards to land uses that are inherent in the soil, improvements needed to overcome these limitations, and the impact that selected land uses will have on the environment.

This soil survey has been prepared for many different users. Farmers, ranchers, and agronomists can use it to determine the potential of the soil and the management practices required for food and fiber production. Planners, community officials, engineers, developers, builders, and home buyers can use it to plan land use, select sites for construction, develop soil resources, or identify any special practices that may be needed to insure proper performance. Conservationists, teachers, students, and specialists in recreation, wildlife management, waste disposal, and pollution control can use the soil survey to help them understand, protect, and enhance the environment.

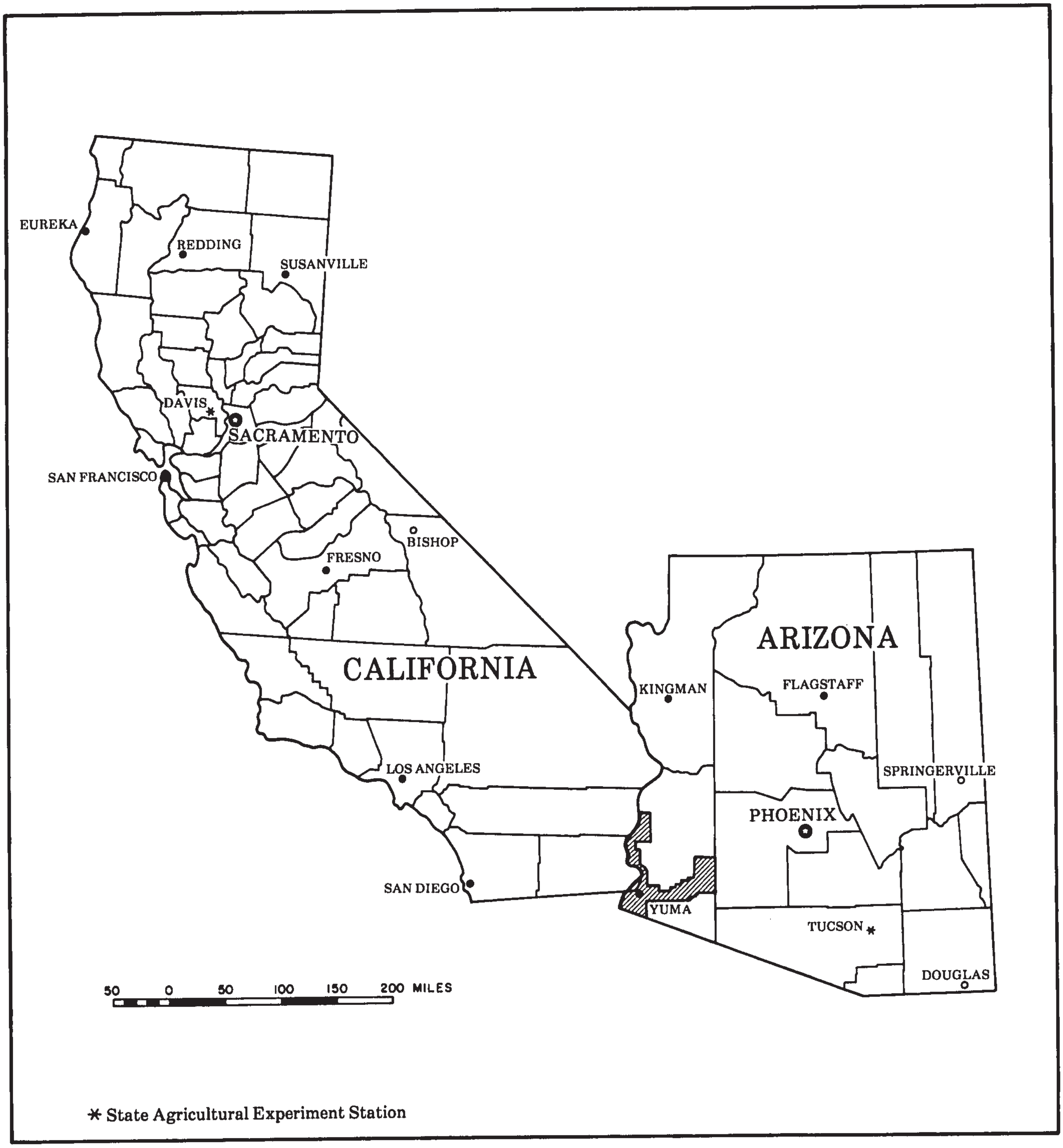
Great differences in soil properties can occur even within short distances. Soils may be seasonally wet or subject to flooding. They may be shallow to bedrock. They may be too unstable to be used as a foundation for buildings or roads. Very clayey or wet soils are poorly suited to septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

These and many other soil properties that affect land use are described in this soil survey. Broad areas of soils are shown on the general soil map; the location of each kind of soil is shown on detailed soil maps. Each kind of soil in the survey area is described, and much information is given about each soil for specific uses. Additional information or assistance in using this publication can be obtained from the local office of the Soil Conservation Service or the Cooperative Extension Service.

This soil survey can be useful in the conservation, development, and productive use of soil, water, and other resources.

Thomas G. Rockenbaugh

Thomas G. Rockenbaugh
State Conservationist
Soil Conservation Service



Location of Yuma-Wellton Area in parts of Yuma County, Arizona, and Imperial County, California.

SOIL SURVEY OF YUMA-WELLTON AREA
PARTS OF YUMA COUNTY, ARIZONA, and IMPERIAL COUNTY, CALIFORNIA

By Russel L. Barmore, Soil Conservation Service

Soils surveyed by Russel L. Barmore, Earl G. Chamberlin, Harlan E. Jacoby, and John P. White, Soil Conservation Service

United States Department of Agriculture, Soil Conservation Service, in cooperation with the Arizona Agricultural Experiment Station and the California Agricultural Experiment Station

YUMA-WELLTON AREA, PARTS OF YUMA COUNTY, ARIZONA, AND IMPERIAL COUNTY, CALIFORNIA, (referred to elsewhere in this survey as Yuma-Wellton Area) is in the southwest corner of Arizona and the southeast corner of California. It has a total area of 1,042,429 acres, or 1,628 square miles. Yuma, the county seat of Yuma County, has a population of 35,000.

The survey area is in the Western Range and Irrigated Region of the Sonoran Desert section of the Basin and Range province. The Colorado River and the All-American Canal form the western boundary. The Gila River is an intermittent stream that flows westerly through the central part of the area. The northern and southern parts consist of old river terraces and broad alluvial fans that are drained by the Gila and Colorado Rivers.

Elevation ranges from 75 feet where the Colorado River enters Mexico to more than 2,000 feet on some of the peaks scattered throughout the survey area.

The climate in the survey area is characterized by moderate temperatures in winter and by hot, dry weather in summer. Precipitation is sporadic. It occurs mainly in the period of July to December.

Farming is the most important industry in the survey area. The main crops are citrus fruit, cotton, alfalfa, small grain, and truck crops. Additional income is provided by military installations and tourism.

General nature of the area

This section briefly discusses the settlement and development, history of irrigated farming, farming, transportation, and climate of the survey area.

Settlement and development

The survey area is rich in cultural history. Hernando de Alarcon, an early Spanish explorer, sailed up the Colorado River past the present site of Yuma in 1540. At that time Indians of the Yuman culture were living along the banks of the Colorado and Gila Rivers.

During the period of the American Revolution, Padre Francisco Garces established two missions in the area. The area south of the Gila River remained in Mexican hands until completion of the Gadsden Purchase in 1854.

In the early days it was impossible for wagon trains to traverse the rugged terrain north of the Gila River. Many immigrants to the California goldfields thus followed the Gila Trail, which crossed the Colorado River where Yuma now stands. By 1875 a number of homesteads had been established in both the Mohawk and Antelope Valleys to the east. Most of the early settlers were probably either miners or persons who worked at the river crossing. The Pony Express and Butterfield-Overland Stage Line did much to encourage settlement. With the extension of the Southern Pacific Railroad into the area in 1877, the area was opened up for development.

The city of Yuma was surveyed by Charles D. Poston, one of Arizona's first legislators, in 1854. By 1880 the population was 1,200, second only to Tucson in the Arizona territory. When Arizona became a state in 1912, Yuma had a population of 6,000. The survey area now has a population of 43,000. Yuma has been experiencing a rapid increase in population since 1960.

Farming is the leading economic enterprise in the area, although government employment and winter visitors contribute significantly to the economy.

History of irrigated farming

Early farmers in the survey area had to rely mainly on the annual spring floods of the Colorado River to provide moisture for crops. When the floods failed, the Indians subsisted on wild plants such as mesquite, Indian tea, and several varieties of cactus. Hernando de Alarcon observed Indians carrying on a form of irrigated farming at the confluence of the Gila and Colorado Rivers, a few

miles above the present site of Yuma. Father Eusabio Kino, while visiting the lower part of Gila Valley in 1700, wrote of seeing little fields of maize, watermelons, calabashes, and beans.

The first white settler in the area to practice irrigation on a large scale was Jose Maria Redondo. The date was about 1870. The irrigation system included reed and earthern dams and a network of about 27 miles of canals to serve 2,000 acres of farmland along the Gila River, just east of its confluence with the Colorado River. These structures undoubtedly were washed out during flooding and had to be rebuilt on a regular basis.

The most significant date for farming in the survey area was June 17, 1902, the date the National Reclamation Act was passed. Under this act, the Secretary of the Interior was authorized to use Federal funds to develop irrigation projects, the cost of which was to be repaid by those using the water.

Under the authority of this act, the Yuma Project was conceived in 1904 and formally approved by the President in 1911. It provided for the development of some 16,000 acres of land in California and for the development of some 55,000 acres in Yuma Valley, 20,000 acres in Gila Valley, and 40,000 acres on the mesa south and east of Yuma. To bring water to the Yuma and Gila Valleys under this project, Laguna Dam was constructed in 1909. After construction of Laguna Dam, farmland in the Yuma and Gila Valleys was rapidly developed. By 1921, 40,000 acres in the Yuma Valley was under cultivation, compared with about 65,000 acres at the present time.

The northern part of Gila Valley also received water from Laguna Dam. The southern part during this time was irrigated with water from privately owned wells. It was not until this part of the valley was included in the Gila Reclamation Project that it was designated to receive Colorado River water.

Later, Congress passed the Boulder Canyon Projects Act of 1928 and the Gila Projects Reauthorization Act of 1947. It was the passage of these two acts that put farming in the Wellton-Mohawk area and on the Yuma Mesa on a sound basis.

When Congress passed the Boulder Canyon Projects Act of 1928 authorizing the construction of Boulder Dam, now known as Hoover Dam, it also authorized the Secretary of the Interior to make studies of the feasibility of using Colorado River water in a reclamation project to be known as the Parker-Gila Valley Reclamation Project. The first unit of the project became known as the Gila Reclamation Project and comprised some 11,000 acres in the northern and southern parts of Gila Valley and 139,000 acres on Yuma Mesa.

After Imperial Dam was constructed in 1938, enough capacity was available in the structures on the Arizona side for development of the Gila Project (figs. 1 and 2). The Wellton-Mohawk area was excluded from the first authorization for the Gila Project. However, it was this area, which was a vital part of the Gila Project Reauthorization Act of 1947, that resulted in th Gila Project as it is today.

With the increase in use of water upstream of the Gila River, especially in the Phoenix area, and with the construction of a series of dams for flood control, farming, and domestic use, the Gila River began to dry up. Deep well pumping became necessary in areas along the Gila River that were not provided with Colorado River water.

By 1940 the area began experiencing a serious salinity problem that required abandonment of many farms. Because of the seriousness of the situation, Congress assisted the Bureau of Reclamation by reducing the size of the Gila Project on the Yuma Mesa and substituting some 75,000 acres located east of the Gila Mountains in the Wellton area. The Gila Project was reauthorized and was to consist of a Yuma Mesa division of about 40,000 acres and a Wellton-Mohawk division of 75,000 acres. In May 1952, Colorado River water was first turned into the Wellton-Mohawk division. This water was first provided to the Texas Hill area.

Farming

Farming is the foundation of the survey area's economy. All the farmland is in or adjacent to river valleys, where there is access to gravity-fed water from the Colorado River irrigation network or to water from wells. About 50 percent, or 322,000 acres, of the arable land has been developed for irrigated farming. Of this total, approximately 42,000 acres is irrigated by water from wells. Most of this acreage is east of the Wellton-Mohawk Irrigation District and Yuma Mesa, which extends to the vicinity of Texas Hill. The supply of good quality irrigation water is the main factor limiting the acreage used as cropland.

The soils in the survey area can be divided into two groups—valley soils and mesa soils. Most farming in the area is done on the valley soils, which have more favorable available water capacity and are more fertile. They generally are silty and clayey. Most of these soils are alkaline, and in some areas salt has accumulated. The valley soils are used to produce alfalfa hay, cotton, sugar beets, small grain, grain sorghum, and vegetables.

The mesa soils are sandy and have low available water capacity and natural fertility. They are on older terraces of the Gila and Colorado River flood plains. These soils require special care for successful farming, but crops can be grown satisfactorily. The soils produce citrus fruit, alfalfa hay, peanuts, and small grain.

In 1975, crops accounted for 79 percent of the total agricultural income and livestock and livestock products accounted for 21 percent. Income generated from the sale of livestock and livestock products has been erratic since about 1970. Most of this was the result of low income from cattle feeding operations.

Of approximately 322,000 acres in cropland in 1975, about 121,000 acres was in wheat, 75,000 acres in alfalfa, 34,000 acres in citrus, 32,000 acres in cotton, and 23,000 acres in lettuce. The remaining acreage, except for that used for date groves, pecan groves, vineyards, bermudagrass, and a few other semipermanent crops, was used in a multiple-cropping program. Such a program includes small grain, melons, safflower, and sugar beets, or it includes a large number of other combinations based largely on the current economic outlook.

The livestock industry generally ranks second to crop production as a source of income. Feedlot operations are most important to the livestock industry, followed by winter pasturing of sheep and swine production. In addition, very small dairy herds and a few head of livestock are kept on irrigated pasture scattered throughout the area. The number of cattle on feedlots varies according to market conditions, generally from 70,000 to 150,000 head each year. Sheep are produced mainly in winter grazing operations. Bred ewes to be pastured on alfalfa and small grain are brought in from summer range at higher elevations.

Swine production at one time totaled 10,000 head. This total has dropped to 5,500. Most of these are raised in feeding operations, but there are a few small breeding herds in the area. With an increase in grain production and improved methods of cooling, swine production could be expected to increase substantially if market conditions justify it.

Transportation

Two major Federal highways serve the survey area. They are Interstate 8, which runs from east to west, and U. S. Highway 95, which runs from north to south. One railroad serves the area, and passenger service is available on Amtrak. The main freight terminal is at Yuma.

The survey area is provided with an air service terminal located at Yuma. Two airlines serve the area.

Climate

Table 1 gives data on temperature and precipitation, as recorded in Yuma Valley, Arizona, during the period 1951-75. Table 2 shows probable dates of the first freeze in fall and the last freeze in spring Table 3 provides data on length of the growing season.

In winter, the average temperature is 55 degrees F and the average daily minimum is 40 degrees. The lowest temperature on record, 19 degrees, occurred in Yuma Valley on January 14, 1963. Temperature inversions and cold air drainage are especially critical to the citrus industry in winter. The air temperature in the groves is generally 10 degrees or more cooler than the air temperature in noncitrus areas. To protect the sensitive trees, the National Weather Service provides daily minimum temperature forecasts in winter. Table 4 gives the number of cold nights that were recorded throughout the survey area from 1964 through 1976.

In summer, the average temperature is 87 degrees and the average daily maximum is 104 degrees.

Growing degree days, shown in table 1, are equivalent to "heat units." During the month, growing degree days accumulate by the amount that the average temperature each day exceeds a base temperature (50 degrees). The normal monthly accumulation is used to schedule single or successive plantings of a crop between the last freeze in spring and the first freeze in fall.

Of the total annual precipitation, 1 inch, or 50 percent, usually falls in April through September, which includes the growing season for most crops. In 2 years out of 10, the April through September rainfall is less than .10 inch. The heaviest 1-day rainfall during the period of record was 1.95 inches in Yuma Valley on September 18, 1963. Thunderstorms occur on about 10 days each year.

The average relative humidity in midafternoon is about 20 percent. Humidity is higher at night in all seasons, and the average at dawn is about 50 percent. In the period from mid-July to mid-September, the moisture content of the air is higher than might be expected in a desert area. This results from a changing wind pattern and the nearness of the Gulf of Lower California. Hot air ballooning upward draws in moisture-laden air from this body of water. During this time, wet bulb temperatures are frequently between 75 to 80 degrees. The percentage of possible sunshine is 95 in summer and 85 in winter. The prevailing direction of the wind is from the north. Average windspeed is highest, 10 miles per hour, in July.

How this survey was made

Soil scientists made this survey to learn what kinds of soil are in the survey area, where they are, and how they can be used. The soil scientists went into the area knowing they likely would locate many soils they already knew something about and perhaps identify some they had never seen before. They observed the steepness, length, and shape of slopes; the size of streams and the general pattern of drainage; the kinds of native plants or crops; the kinds of rock; and many facts about the soils. They dug many holes to expose soil profiles. A profile is the sequence of natural layers, or horizons, in a soil; it extends from the surface down into the parent material, which has been changed very little by leaching or by the action of plant roots.

The soil scientists recorded the characteristics of the profiles they studied, and they compared those profiles with others in counties nearby and in places more distant. Thus, through correlation, they classified and named the soils according to nationwide, uniform procedures.

After a guide for classifying and naming the soils was worked out, the soil scientists drew the boundaries of the individual soils on aerial photographs. These photographs show buildings, field borders, roads, and other details that help in drawing boundaries accurately. The soil map at the back of this publication was prepared from aerial photographs.

The areas shown on a soil map are called soil map units. Some map units are made up of one kind of soil, others are made up of two or more kinds of soil, and a few have little or no soil material at all. Map units are discussed in the sections "General soil map for broad land use planning" and "Soil maps for detailed planning."

While a soil survey is in progress, samples of soils are taken as needed for laboratory measurements and for engineering tests. The soils are field tested, and interpretations of their behavior are modified as necessary during the course of the survey. New interpretations are added to meet local needs, mainly through field observations of different kinds of soil in different uses under different levels of management. Also, data are assembled from other sources, such as test results, records, field experience, and information available from state and local specialists. For example, data on crop yields under defined practices are assembled from farm records and from field or plot experiments on the same kinds of soil.

But only part of a soil survey is done when the soils have been named, described, interpreted, and delineated on aerial photographs and when the laboratory data and other data have been assembled. The mass of detailed information then needs to be organized so that it is readily available to different groups of users, among them farmers, managers of rangeland and woodland, engineers, planners, developers and builders, home buyers, and others.

General soil map for broad land use planning

The general soil map at the back of this publication shows, in color, map units that have a distinct pattern of soils and of relief and drainage. Each map unit is a unique natural landscape. Typically, a map unit consists of one or more major soils and some minor soils. It is named for the major soils. The soils making up one unit can occur in other units but in a different pattern.

The general soil map provides a broad perspective of the soils and landscapes in the survey area. It provides a basis for comparing the potential of large areas for general kinds of land use. Areas that are, for the most part, suited to certain kinds of farming or to other land uses can be identified on the map. Likewise, areas of soils having properties that are distinctly unfavorable for certain land uses can be located.

Because of its small scale, the map does not show the kind of soil at a specific site. Thus, it is not suitable for planning the management of a farm or field or for selecting a site for a road or building or other structure. The kinds of soil in any one map unit differ from place to place in slope, depth, stoniness, drainage, or other characteristics that affect their management.

The general soil map at the back of this survey does not join, in all instances, with the general soil maps of adjacent survey areas. Differences in the maps have resulted from the differences in the occurrence of soil patterns and from recent advances in classification.

The eight map units in this survey area are described in the following pages.

1. Holtville-Gadsden-Kofa

Deep, nearly level, well drained, clayey soils; on flood plains and low terraces

This map unit is on the Colorado River flood plain and low terraces. It is in Bard Valley, California, and Yuma Valley, Arizona.

This unit makes up about 11 percent of the survey area. About 25 percent of the unit is Holtville soils, 20 percent is Gadsden soils, 15 percent is Kofa soils, and 40 percent is soils of minor extent.

The soils in this unit have clay in the upper part of the profile. The Holtville soils are underlain by very fine sandy loam or silty clay loam below a depth of 20 to 36 inches, the Gadsden soils are clay to a depth of 60 inches or more, and the Kofa soils are underlain by sand at a depth of 20 to 36 inches.

Minor in this unit are the well drained Gilman, Glenbar, and Vint soils. These soils occur at random throughout the unit.

This unit is used for irrigated cotton, bermudagrass, alfalfa hay, small grain, and truck crops. Because of slow permeability, the soils are marginally suited to citrus fruit. The community of Gadsden and the town of Somerton are on these soils. In addition, an increasing number of subdivisions have recently been built on this unit west of Yuma.

This unit is limited for sanitary facilities and community development because of the slow permeability and high shrink-swell potential of the clay layers.

2. Indio-Ripley-Lagunita

Deep, nearly level to gently sloping, well drained and somewhat excessively drained, silty and sandy soils; on flood plains, low terraces, and alluvial fans and in drainageways

This map unit is on the Gila River flood plain.

This unit makes up about 20 percent of the survey area. About 55 percent of the unit is Indio soils, 15

percent is Ripley soils, 15 percent is Lagunita soils, and 15 percent is soils of minor extent.

Indio and Ripley soils are well drained and are silty in the upper part of the profile. Indio soils are underlain by silt loam, and Ripley soils are underlain by sand. Lagunita soils are somewhat excessively drained and are sandy throughout.

Minor in this unit are the well drained Gilman, Glenbar, and Vint soils.

This unit is used mainly for irrigated alfalfa hay, cotton, small grain, and truck crops.

The hazard of flooding is the main limitation for sanitary facilities and community development.

3. Rositas-Superstition

Deep, nearly level to undulating, somewhat excessively drained, sandy soils; on old terraces, alluvial fans, and sand dunes

This map unit is along the Colorado and Gila Rivers. It is referred to locally as the Yuma Mesa.

This unit makes up about 12 percent of the survey area. About 50 percent of the unit is Rositas soils, 35 percent is Superstition soils, and 15 percent is soils of minor extent.

The Rositas soils are undulating and are on the higher terraces, alluvial fans, and sand dunes. The Superstition soils are nearly level and are on terraces. The vegetation is big galleta on the Rositas soils and creosotebush on the Superstition soils. Both soils are sandy throughout, but the Superstition soils are not so red as the Rositas soils and have accumulations of lime below a depth of about 14 inches.

Minor in this unit are the well drained Ligurta and Cristobal soils. These soils are in small depressions on the higher terraces. They have a surface cover of varnished desert pavement.

The soils in this unit are mainly in desert vegetation, but a part of Yuma Mesa is used for high-value citrus fruit and alfalfa hay. Also, a part of the city of Yuma is on these soils.

These soils have slight limitations for most kinds of community development. Windbreaks and other kinds of cover help to control soil blowing.

4. Dateland-Wellton

Deep, nearly level, well drained, loamy soils; on old alluvial fans and high terraces

This map unit is along the Gila River. It is between the Gila and Mohawk Mountains.

This unit makes up about 5 percent of the survey area. About 40 percent of this unit is Dateland soils, 40 percent is Wellton soils, and 20 percent is soils of minor extent.

The Dateland soils are on the lower part of the alluvial fans and terraces adjacent to the Gila River. They are fine sandy loam and loam throughout. Some areas have a loamy fine sand or loam surface layer. The Wellton soils are on the higher part of the alluvial fans and terraces. They have a loamy sand surface layer and a fine gravelly sandy loam subsoil.

Minor in this unit are the well drained Antho soils and the excessively drained Carrizo soils in drainageways, the well drained Tremant and Cristobal soils on old alluvial fans, and the somewhat excessively drained Rositas soils on sand dunes.

The soils in this unit are used mainly for limited livestock grazing. About 20 percent of the unit is used for irrigated citrus fruit and alfalfa hay.

The soils in this unit are slightly limited for sanitary facilities, community development, and recreational facilities.

5. Ligurta-Cristobal-Carrizo

Deep, nearly level, well drained and excessively drained, gravelly and very gravelly soils; on alluvial fans, low terraces, and flood plains

This map unit is on terraces along the Colorado and Gila Rivers, on broad old alluvial fans in the eastern part of the survey area, and on flood plains throughout the area.

This unit occupies about 24 percent of the survey area. About 40 percent of this unit is Ligurta soils, 30 percent is Cristobal soils, 15 percent is Carrizo soils, and 15 percent is soils of minor extent.

The well drained Ligurta soils are on the lower slopes of alluvial fans and low terraces, and the well drained Cristobal soils are on the higher slopes. Both soils have a surface of dense, varnished desert pavement over a fluffy, strongly saline subsoil. The Ligurta soils are less than 35 percent gravel in the subsoil, and the Cristobal soils are more than 35 percent gravel. The excessively drained Carrizo soils are on flood plains and alluvial fans and are very gravelly sand throughout.

Minor in this unit are the well drained Antho and Tremant soils and the somewhat excessively drained Rositas soils.

The soils of this unit are in desert vegetation.

High salinity in the Ligurta and Cristobal soils and high content of gravel in all the soils are the main limitations for farming. On the Ligurta and Cristobal soils, slow permeability and moderate shrink-swell potential are the main limitations for septic tank absorption fields, community development, and recreational facilities. The main limitation on the Carrizo soils for these uses is the hazard of flooding.

6. Tremant-Harqua-Rositas

Deep, nearly level, well drained and somewhat excessively drained, gravelly and sandy soils; on terraces, alluvial fans, and sand dunes

This map unit is in the eastern part of the survey area.

This unit occupies about 14 percent of the survey area. About 50 percent of this unit is Tremant soils, 30 percent is Harqua soils, 15 percent is Rositas soils, and 5 percent is soils of minor extent.

The well drained Tremant soils are on the lower part of the terraces that separate areas of Harqua soils. They have a loam or gravelly loam surface layer and a gravelly clay loam subsoil. The well drained Harqua soils are on the higher part of the terraces. They have a gravelly loam surface layer and a gravelly clay loam subsoil, and they are saline. These soils have a surface cover of desert pavement. The somewhat excessively drained, sandy Rositas soils occur as sand dunes that are scattered throughout the unit.

Minor in this unit are the well drained Antho, Gachado, and Indio soils and the excessively drained Carrizo soils.

The soils of this unit are mainly in undisturbed desert vegetation, but some areas near Aztec and Hyder are cultivated.

High salinity of the Harqua soils, the gravelly surface of the Tremant soils, and the sandy texture of the Rositas soils are the main limitations for farming. If the Harqua soils are leached, they and the Tremant and Rositas soils are well suited to alfalfa hay, cotton, small grain, and safflower.

Seepage on the Rositas soils and moderate shrink-swell potential on the Harqua and Tremant soils are the main limitations for sanitary facilities and community development.

7. Cherioni-Rock outcrop

Very shallow and shallow, gently sloping to steep, well drained, extremely cobbly soils, and Rock outcrop; on hills and mountains

This map unit is in the eastern part of the survey area.

This unit occupies about 2 percent of the survey area. About 55 percent of the unit is Cherioni soils, 30 percent is Rock outcrop, and 15 percent is soils of minor extent.

The Cherioni soils have both a hardpan and bedrock at a depth of less than 20 inches. They are on hills and on the lower slopes of mountains. They formed in material weathered from andesite, basalt, and rhyolite. Rock outcrop consists of exposures of volcanic rock on peaks and ridge crests.

Minor in this unit are the well drained Gachado soils and areas of limy colluvium at the base of the mountains.

This unit is in undisturbed native vegetation.

This unit is poorly suited to crops, sanitary facilities, community development, and recreational facilities. Excessive slope, an extremely cobbly surface, and shallow depth to bedrock are the main limitations for these uses.

8. Laposa-Rock outcrop

Moderately deep, steep, well drained, extremely gravelly soils, and Rock outcrop; on hills and mountains

This map unit is mainly in the Gila, Mohawk, and Trigo Mountains.

This unit occupies about 12 percent of the survey area. About 40 percent of the unit is Laposa soils, 25 percent is Rock outcrop, and 35 percent is soils of minor extent.

The Laposa soils are underlain by bedrock at a depth of 20 to 40 inches. They are very gravelly loam and are on steep side slopes. They formed in material weathered from granite, gneiss, schist, andesite, and rhyolite. Rock outcrop consists of exposures of rock on the peaks and crests of hills and mountains.

Minor in this unit are the well drained Ligurta and Cristobal soils and the excessively drained Carrizo soils.

This unit is in undisturbed desert vegetation.

This unit is poorly suited to crops, sanitary facilities, and urban development. Steepness of slope and high content of gravel are the main limitations for these uses.

Soil maps for detailed planning

The map units shown on the detailed soil maps at the back of this publication represent the kinds of soil in the survey area. They are described in this section. The descriptions together with the soil maps can be useful in determining the potential of a soil and in managing it for food and fiber production; in planning land use and developing soil resources; and in enhancing, protecting, and preserving the environment. More information for each map unit, or soil, is given in the section "Use and management of the soils."

Preceding the name of each map unit is the symbol that identifies the soil on the detailed soil maps. Each soil description includes general facts about the soil and a brief description of the soil profile. In each description, the principal hazards and limitations are indicated and the management concerns and practices needed are discussed.

The map units on the detailed soil maps represent an area on the landscape made up mostly of the soil or soils for which the unit is named. Most of the delineations shown on the detailed soil map are phases of soil series.

Soils that have a profile that is almost alike make up a *soil series*. Except for allowable differences in texture of the surface layer or of the substratum, all the soils of a series have major horizons that are similar in composi-

tion, thickness, and arrangement in the profile. A soil series commonly is named for a town or geographic feature near the place where a soil of that series was first observed and mapped.

Soils of one series can differ in texture of the surface layer or in the substratum and in slope, erosion, stoniness, salinity, wetness, or other characteristics that affect their use. On the basis of such differences, a soil series is divided into phases. The name of a *soil phase* commonly indicates a feature that affects use or management. For example, Indio silt loam is one of several phases within the Indio series.

Some map units are made up of two or more dominant kinds of soil. One such kind of map unit is shown on the soil map of this survey area: complex.

A *soil complex* consists of areas of two or more soils that are so intricately intermingled or so small in size that they cannot be shown separately on the soil map. Each area includes some of each of the two or more dominant soils, and the pattern and proportion are somewhat similar in all areas. Harqua-Tremant complex is an example.

Most map units include small, scattered areas of soils other than those that appear in the name of the map unit. Some of these soils have properties that differ substantially from those of the dominant soil or soils and thus could significantly affect use and management of the map unit. These soils are described in the description of each map unit. Some of the more unusual or strongly contrasting soils that are included are identified by a special symbol on the soil map.

Most mapped areas include places that have little or no soil material and support little or no vegetation. Such places are called *miscellaneous areas*; they are delineated on the soil map and given descriptive names. Rock outcrop is an example. Some of these areas are too small to be delineated and are identified by a special symbol on the soil map.

The acreage and proportionate extent of each map unit are given in table 5, and additional information on properties, limitations, capabilities, and potentials for many soil uses is given for each kind of soil in other tables in this survey. (See "Summary of tables.") Many of the terms used in describing soils are defined in the Glossary.

Soil descriptions

1—Antho sandy loam. This deep, well drained, nearly level soil is on flood plains and low terraces. It formed in mixed alluvium weathered from andesite, rhyolite, and granite. Elevation is 75 to 1,200 feet. The average annual precipitation ranges from 2 to 4 inches, the average annual air temperature ranges from 72 to 76 degrees F, and the average freeze-free period ranges from 250 to 325 days.

Typically, the surface layer is light yellowish brown sandy loam about 4 inches thick. The underlying material to a depth of 60 inches or more is stratified sandy loam and fine sandy loam. In some areas the surface layer is gravelly sandy loam or loam.

Included with this soil in mapping are small areas of Gilman loam, Indio silt loam, and Vint loamy fine sand.

Permeability of this Antho soil is moderately rapid. Potential rooting depth is more than 60 inches. Available water capacity is moderate. Surface runoff is slow. The hazard of soil blowing is high. This soil normally is subject to rare flooding, but it is now protected by dams or levees, or both, on the Colorado and Gila Rivers.

This soil is used mainly for irrigated cotton, alfalfa hay, small grain, vegetables, and grain sorghum. Some areas are used for limited livestock grazing.

If this soil is irrigated, it is suited to all adapted crops. All crops respond to nitrogen fertilizer, especially if a legume is not included in the cropping system. Phosphorus may be needed if alfalfa and other legumes are grown. Organic matter content, soil tilth, water intake rate, and other factors of soil condition can be maintained or improved by returning crop residue and adding manure to the soil. The risk of soil blowing can be reduced by growing a cover crop.

Irrigation water can be applied efficiently by using sprinkler, low pressure emitter, border, or furrow irrigation systems. Border and furrow systems are less efficient if all systems are operated at maximum potential. Border and furrow systems require land preparation. Among the suitable land preparation practices are leveling the soil and determining the proper length of runs and the proper width of borders. Water can be distributed by earth ditches, lined ditches, or pipelines. The moisture content of the soil should be determined before applying irrigation water, and then the correct amount of water should be applied at the right time. The amount of irrigation water applied should be measured to obtain high irrigation efficiency. Tailwater should be eliminated, or water recovery systems or pumpback systems, or both, should be used.

The potential plant community is mainly big galleta, creosotebush, white bursage, range ratany, ocotillo, and annual forbs.

Palatable forage plants are more abundant on this soil than on most of the other soils in the survey area, but their use by livestock is limited by the variability of forage production and the lack of livestock watering facilities. The hazard of soil blowing is increased if plant cover is not preserved. Windbreaks and other kinds of cover help to control soil blowing.

Nonirrigated areas of this soil have poor potential for rangeland wildlife habitat. Water development is one of the more important practices used when managing this soil for wildlife habitat. Irrigated areas have good potential for openland wildlife habitat and fair potential for wetland wildlife habitat. Leaving brushy areas and large

trees along field borders and managing wet areas are important practices in irrigated areas. Typical reptiles on this soil are desert iguana, sidewinder, and zebra-tailed lizard. Typical mammals are kangaroo rat, pocket mouse, and black-tailed jackrabbit.

This soil is slightly limited for urban and recreational development and for septic tank absorption fields. In populated areas, central sewage systems may be needed to prevent contamination of the ground water supply.

This soil is in capability unit IIs-7, irrigated, and capability subclass VIIc, nonirrigated.

2—Antho fine sandy loam. This deep, well drained, nearly level soil is on flood plains and low terraces. It formed in mixed alluvium. Elevation is 75 to 1,200 feet. The average annual precipitation ranges from 2 to 4 inches, the average annual air temperature ranges from 72 to 76 degrees F, and the average freeze-free period ranges from 250 to 325 days.

Typically, the surface layer is light yellowish brown fine sandy loam about 3 inches thick. The underlying material to a depth of 60 inches or more is stratified light yellowish brown and brownish yellow sandy loam, coarse sandy loam, gravelly sandy loam, and gravelly coarse sandy loam. In some areas the surface layer is gravelly sandy loam or loam.

Included with this soil in mapping are small areas of Gilman loam, Indio silt loam, and Vint loamy fine sand.

Permeability of the Antho soil is moderately rapid. Potential rooting depth is 60 inches or more. Available water capacity is moderate. Surface runoff is slow. The hazard of soil blowing is high. This soil normally is subject to rare flooding, but it is now protected by dams or levees, or both, on the Colorado and Gila Rivers.

This soil is used mainly for irrigated cotton, alfalfa hay, vegetables, small grain, and grain sorghum. Some areas are used for limited livestock grazing.

If this soil is irrigated, it is suited to all adapted crops. All crops respond to nitrogen fertilizer, especially if a legume is not included in the cropping system. Phosphorus may be needed if alfalfa and other legumes are grown. Organic matter content, soil tilth, water intake rate, and other factors of soil condition can be maintained or improved by returning crop residue and adding manure to the soil. The risk of soil blowing can be reduced by growing a cover crop.

Irrigation water can be applied efficiently by using sprinkler, low pressure emitter, border, or furrow irrigation systems. Border and furrow systems are less efficient if all systems are operated at maximum potential. Border and furrow systems require land preparation. Among the suitable land preparation practices are leveling the soil and determining the proper length of runs and the proper width of borders. Water can be distributed by earth ditches, lined ditches, or pipelines. The moisture content of the soil should be determined before applying irrigation water, and then the correct amount of water should be applied at the right time. The amount of irrigation water applied should be measured to obtain high irrigation efficiency. Tailwater should be eliminated, or water recovery systems or pumpback systems, or both, should be used.

The potential plant community is mainly big galleta, creosotebush, white bursage, range ratany, ocotillo, and annual forbs.

Palatable forage plants are more abundant on this soil than on most of the other soils in the survey area, but their use by livestock is limited by the variability of forage production and the lack of livestock watering facilities. The hazard of soil blowing is increased if plant cover is not preserved. Windbreaks and other kinds of cover help to control soil blowing.

Nonirrigated areas of this soil have poor potential for rangeland wildlife habitat. Water development is one of the more important practices used when managing the soil for wildlife habitat. Irrigated areas have good potential for openland wildlife habitat and fair potential for wetland wildlife habitat. Leaving brushy areas and large trees along field borders and managing wet areas are important practices in irrigated areas. Typical reptiles on this soil are desert iguana, sidewinder, and zebra-tailed lizard. Typical mammals are kangaroo rat, pocket mouse, and black-tailed jackrabbit.

This soil is slightly limited for urban and recreational development and for septic tank absorption fields. In populated areas, central sewage systems may be needed to prevent contamination of the ground water supply.

This soil is in capability unit IIs-7, irrigated, and capability subclass VIIs, nonirrigated.

3—Carrizo very gravelly sand. This deep, nearly level to moderately sloping, excessively drained soil is on flood plains and recent alluvial fans. It formed in mixed alluvium. Elevation is 100 to 1,200 feet. The average annual precipitation ranges from 2 to 4 inches, the average annual air temperature ranges from 72 to 76 degrees F, and the average freeze-free period ranges from 250 to 325 days.

Typically, the surface layer is light brown very gravelly sand about 3 inches thick. The underlying material to a depth of 64 inches or more is light brown and pink very gravelly sand, very gravelly coarse sand, and gravelly loamy sand and has thin strata of loam. In some places the surface layer is very gravelly loamy sand.

Included with this soil in mapping are small areas of Lagunita loamy sand, Indio silt loam, and Antho sandy loam.

Permeability of this Carrizo soil is very rapid. Potential rooting depth is 64 inches or more. Available water capacity is very low. Surface runoff is slow except during rare torrential showers. The hazard of erosion is high

during these showers. This soil is subject to rare flooding.

This soil is mainly in undisturbed native vegetation. A few areas are in irrigated crops. Where the soil is farmed, it is intermingled with areas of other soils that are more desirable for farming. Some small areas are used for limited livestock grazing.

If this soil is irrigated, it is suited to all adapted crops. Commercial fertilizer is needed in addition to manure and plant residue. Sprinkler and drip systems of irrigation are suitable for use on this soil. Because of the limited available water capacity, crops require light and frequent applications of water.

The potential plant community is mainly big galleta, creosotebush, littleleaf paloverde, mesquite, ironwood, and sixweeks fescue.

This soil produces very little forage that is suitable for livestock grazing, but in places it provides areas of shade along dry stream channels. It is important to preserve the vegetation along the stream channels to control the erosion that results from flooding.

Nonirrigated areas of this soil have poor potential for rangeland wildlife habitat. Areas that are subject to flooding commonly support desert riparian vegetation. They are important food and cover areas for wildlife. Typical reptiles on this soil are collared lizard, zebra-tailed lizard, and desert side-blotched lizard. Typical mammals are desert cottontail rabbit, deer mouse, woodrat, gray fox, bobcat, and mule deer. Typical birds are Gila woodpecker, verdin, wrens, crissal thrasher, black-tailed gnatcatcher, and black-throated sparrow.

This soil is severely limited for urban development because of the hazard of flooding. It is severely limited for recreational development because of the hazard of flooding, the content of sand and gravel, and slope. This soil is severely limited for septic tank absorption fields because of the hazard of flooding. In populated areas, central sewage disposal systems may be needed to prevent contamination of the ground water supply.

This soil is in capability unit IVs-4, irrigated, and capability subclass VIIs, nonirrigated.

4—Cherioni-Rock outcrop complex, 25 to 70 percent slopes. This complex is on volcanic hills and mountains. Elevation is 400 to 1,600 feet. The average annual precipitation ranges from 2 to 4 inches, the average annual air temperature ranges from 72 to 76 degrees F, and the average freeze-free period ranges from 250 to 325 days.

The Cherioni soil makes up about 55 percent of this complex and Rock outcrop about 30 percent. A Gachado soil and a limy colluvial soil at the base of mountains and hills make up the remaining 15 percent.

The Cherioni soil is very shallow and shallow and well drained. It formed in residuum and colluvium. Typically, 90 percent of this soil is covered with basalt cobbles. The surface layer is light yellowish brown extremely cobbly loam about 5 inches thick. The underlying material is very pale brown extremely gravelly loam about 7 inches thick over a silica- and lime-cemented duripan 2 inches thick. It is underlain by extremely hard basalt bedrock. In some places the surface layer is very cobbly loam, very cobbly fine sandy loam, or very cobbly sandy loam.

Permeability of the Cherioni soil is moderate in the upper part of the profile and very slow in the duripan. Potential rooting depth is 5 to 20 inches. Available water capacity is very low. Surface runoff is medium, and the hazard of water erosion is slight.

Rock outcrop consists of areas of exposed andesite, basalt, and rhyolite. Runoff is rapid.

This complex is used as watershed and open space. It should be maintained in its native plant cover.

The potential plant community is mainly white brittlebush and creosotebush.

This complex has poor potential for livestock grazing because of the steep, rocky terrain and the low palatability of the native vegetation.

This complex has poor potential for rangeland wildlife habitat. The many crevices in the Rock outcrop are suitable as places for animals to rest, nest, and raise their young. The Rock outcrop also provides hunting perches for birds of prey. Development of water catchments is one of the most important practices in managing this complex for wildlife habitat. Typical birds in this complex are red-tailed hawk, owls, swallows, and wrens. Typical reptiles are Arizona chuckwalla, spiny lizard, western blackheaded snake, and western diamondback rattlesnake. Typical mammals are bats, woodrats, Yuma antelope squirrel, and bobcat.

This complex has very poor potential for farming, sanitary facilities, community development, and recreational facilities because of excessive slope, the very cobbly surface, and the presence of bedrock within 20 inches of the surface.

This complex is in capability subclass VIIe, nonirrigated.

5—Dateland loamy fine sand. This deep, well drained soil is on broad alluvial fans. It formed in mixed alluvium. Elevation is 200 to 600 feet. The average annual precipitation ranges from 2 to 4 inches, the average annual air temperature ranges from 72 to 76 degrees F, and the average freeze-free period ranges from 250 to 325 days.

Typically, the surface layer is light brown loamy fine sand about 6 inches thick. The subsoil is light yellowish brown and pale brown fine sandy loam and loam about 32 inches thick. The substratum to a depth of 60 inches or more is yellowish red, reddish yellow, and pink gravelly sandy loam and sandy loam.

Included with this soil in mapping are small areas of Dateland fine sandy loam, Wellton loamy sand, and Antho sandy loam.

Permeability of this Dateland soil is moderately rapid. Potential rooting depth is 60 inches or more. Available water capacity is moderate. Surface runoff is slow. The hazard of soil blowing is high.

This soil is used mainly for irrigated citrus fruit, cotton, alfalfa hay, vegetables, small grain, and grain sorghum. Some areas are used for limited livestock grazing.

If this soil is irrigated, it is suited to all adapted crops. All crops respond to nitrogen fertilizer, especially if a legume is not included in the cropping system. Phosphorus may be needed if alfalfa and other legumes are grown. Organic matter content, soil tilth, water intake rate, and other factors of soil condition can be maintained or improved by returning crop residue and adding manure to the soil. The risk of soil blowing can be reduced by growing a cover crop.

Irrigation water can be applied efficiently by using sprinkler, low pressure emitter, border, or furrow irrigation systems. Border and furrow systems are less efficient if all systems are operated at maximum potential. Border and furrow systems require land preparation. Among the suitable land preparation practices are leveling the soil and determining the proper length of runs and the proper width of borders. Water can be distributed by earth ditches, lined ditches, or pipelines. The moisture content of the soil should be determined before applying irrigation water, and then the correct amount of water should be applied at the right time. The amount of irrigation water applied should be measured to obtain high irrigation efficiency. Tailwater should be eliminated, or water recovery systems or pumpback systems, or both, should be used.

The potential plant community is mainly creosotebush, white bursage, range ratany, ratany, and galleta.

Palatable forage plants are more abundant on this soil than on most of the other soils in the survey area, but their use by livestock is limited by the variability of forage production and the lack of livestock watering facilities. The hazard of soil blowing is high if the native plant cover is not preserved. Windbreaks and other kinds of cover help to control soil blowing.

Nonirrigated areas of this soil have poor potential for rangeland wildlife habitat. Water development is one of the more important practices used when managing this soil for wildlife habitat. Irrigated areas have good potential for openland wildlife habitat and poor potential for wetland wildlife habitat. Leaving native brushy areas and large trees along field borders is an important practice in management for wildlife habitat in irrigated areas. Typical reptiles on this soil are collared lizard, desert spiny lizard, and desert side-blotched lizard. Typical mammals are black-tailed jackrabbit, round-tailed ground squirrel, and Yuma antelope squirrel.

This soil is well suited to urban and recreational development. It provides good sites for road location. It is suited to those lawn grasses, shrubs, and trees that are not sensitive to lime, which induces chlorosis. An annual application of iron chelate reduces this problem.

This soil is in capability unit IIs-7, irrigated, and capability subclass VIIs, nonirrigated.

6—Dateland fine sandy loam. This deep, well drained soil is on broad alluvial fans. It formed in mixed alluvium. Elevation is 200 to 600 feet. The average annual precipitation ranges from 2 to 4 inches, the average annual air temperature ranges from 72 to 76 degrees F, and the average freeze-free period ranges from 250 to 325 days.

Typically, the surface layer is brown fine sandy loam about 6 inches thick. The subsoil is light yellowish brown fine sandy loam 21 inches thick. The substratum to a depth of 60 inches or more is pale brown loam and fine sandy loam.

Included with this soil in mapping are small areas of Dateland loamy fine sand, Wellton loamy sand, and Antho sandy loam.

Permeability of this Dateland soil is moderately rapid. Potential rooting depth is 60 inches or more. Available water capacity is moderate. Surface runoff is moderate. The hazard of soil blowing is high.

This soil is used mainly for irrigated cotton, citrus fruit, alfalfa hay, small grain, grain sorghum, and vegetables. Some areas are used for livestock grazing.

If this soil is irrigated, it is suited to all adapted crops. All crops respond to nitrogen fertilizer, especially if a legume is not included in the cropping system. Phosphorus may be needed if alfalfa and other legumes are grown. Organic matter content, soil tilth, water intake rate, and other factors of soil condition can be maintained or improved by returning crop residue and by adding manure to the soil. The risk of soil blowing can be reduced by growing a cover crop.

Irrigation water can be applied efficiently by using sprinkler, low pressure emitter, border, or furrow irrigation systems. Border and furrow systems are less efficient if all systems are operated at maximum potential. Border and furrow systems require land preparation. Among the suitable land preparation practices are leveling the soil and determining the proper length of runs and the proper width of borders. Water can be distributed by earth ditches, lined ditches, and pipelines. The moisture content of the soil should be determined before applying irrigation water, and then the correct amount of water should be applied at the right time. The amount of irrigation water applied should be measured to obtain high irrigation efficiency. Tailwater should be eliminated, or water recovery systems or pumpback systems, or both, should be used.

The potential plant community is mainly creosotebush, white bursage, range ratany, ratany, and galleta.

Palatable forage plants are more abundant on this soil than on most of the other soils in the survey area, but their use by livestock is limited by the variability of forage

production and the lack of livestock watering facilities. The hazard of soil blowing is high if the native plant cover is not preserved. Windbreaks and other kinds of cover help to control soil blowing.

Nonirrigated areas of this soil have poor potential for rangeland wildlife habitat. Water development is one of the more important practices used when managing this soil for wildlife habitat. Irrigated areas have good potential for openland wildlife habitat and poor potential for wetland wildlife habitat. Leaving native brushy areas and large trees along field borders and managing wet areas are important practices in irrigated areas. Typical reptiles on this soil are collared lizard, desert spiny lizard, and desert side-blotched lizard. Typical mammals are black-tailed jackrabbit, round-tailed ground squirrel, and Yuma antelope squirrel.

This soil is well suited to urban and recreational development. It is suited to those lawn grasses, shrubs, and trees that are not sensitive to lime, which induces chlorosis. An annual application of iron chelate reduces this problem.

This soil is in capability unit IIs-7, irrigated, and capability subclass VIIs, nonirrigated.

7—Gachado very gravelly loam. This very shallow and shallow, well drained, gently sloping to moderately sloping soil is on low hills and on toe slopes of mountains. It formed in material derived from basalt, andesite, and tuff. Elevation is 400 to 1,300 feet. The average annual precipitation ranges from 2 to 4 inches, the average annual air temperature ranges from 72 to 76 degrees F, and the average freeze-free period ranges from 250 to 325 days.

Typically, the surface layer is pink very gravelly loam about 1 inch thick. The subsoil is pink extremely gravelly sandy clay loam and reddish yellow extremely gravelly loam about 11 inches thick over extremely hard basalt bedrock that has a thin coating of pinkish white lime. Bedrock is at a depth of 9 to 20 inches.

Included with this soil in mapping are small areas of Antho sandy loam, Tremant gravelly loam, and Rositas sand.

Permeability of this Gachado soil is slow. Potential rooting depth is 9 to 20 inches. Available water capacity is low. Surface runoff is medium, and the hazard of water erosion is slight.

This soil is used for limited livestock grazing.

The native vegetation is almost nonexistent on this soil. The included soils in this unit produce most of the vegetation. The vegetation is mainly big galleta, threeawn, sixweeks grama, creosotebush, triangleleaf bursage, range ratany, white ratany, and annual forbs. This unit should be managed for the included soils.

Livestock grazing is limited by wide variability in the production of forage and by shortage of livestock watering facilities. Grazing management that helps to maintain the native plant cover is important.

Nonirrigated areas of this soil have poor potential for wetland and openland wildlife habitat. Typical reptiles on this soil are zebra-tailed lizard, Great Basin whiptail, western diamondback rattlesnake, and Arizona chuckwalla. Typical mammals are coyote, bobcat, and round-tailed ground squirrel. Typical birds are loggerhead shrike, verdin, and red-tailed hawk.

This soil is severely limited for community development and sanitary facilities because of the depth to bedrock and content of small stones. It is severely limited for septic tank absorption fields because of depth to bedrock and slow permeability.

This soil is in capability subclass VIIe, nonirrigated.

8—Gadsden clay. This deep, well drained, nearly level soil is on flood plains and low terraces. It formed in mixed alluvium. Elevation is 75 to 600 feet. The average annual precipitation ranges from 2 to 4 inches, the average annual air temperature ranges from 72 to 76 degrees F, and the freeze-free period ranges from 250 to 325 days.

Typically, the surface layer is brown clay about 16 inches thick. The underlying material to a depth of 60 inches or more is very pale brown heavy silty clay loam and light brown clay.

Included with this soil in mapping are small areas of Holtville clay, Kofa clay, and Glenbar silty clay loam.

Permeability of this Gadsden soil is slow. Potential rooting depth is 60 inches or more. Available water capacity is high. Surface runoff is rapid, and the hazard of water erosion is slight. This soil is normally subject to rare flooding, but it is now protected by dams or levees, or both, on the Colorado and Gila Rivers.

This soil is used mainly for irrigated grain sorghum, cotton, alfalfa hay, bermudagrass, sugar beets, vegetables, citrus, and small grain (fig. 3).

If this soil is irrigated, it is suited to all adapted crops. All crops respond to nitrogen fertilizer, especially if a legume is not included in the cropping system. Phosphorus may be needed if alfalfa and other legumes are grown. Organic matter content, soil tilth, water intake rate, and other factors of soil condition can be maintained or improved by returning crop residue and adding manure to the soil. Permeability of the soil can be maintained or improved by adding extra amounts of organic matter to the soil and by growing deep-rooted plants. Deep chiseling or subsoiling can also be used, but the beneficial effect is temporary.

Irrigation water can be applied efficiently by using sprinkler, low pressure emitter, basin, border, or furrow irrigation systems. Border and furrow systems are less efficient if all systems are operated at maximum potential. Border and furrow systems require land preparation. Among the suitable land preparation practices are leveling the soil and determining the proper length of runs and the proper width of borders. Water can be distributed by earth ditches, lined ditches, or pipelines. The mois-

ture content of the soil should be determined before applying irrigation water, and then the correct amount of water should be applied at the right time. The amount of irrigation water applied should be measured to obtain high irrigation efficiency. Tailwater should be eliminated, or water recovery systems or pumpback systems, or both, should be used.

Irrigated areas of this soil have fair potential for openland wildlife habitat and good potential for wetland wildlife habitat. A suitable method of managing this soil for wildlife habitat is to plant or leave woody vegetation along field borders. Typical mammals are valley pocket gopher and deer mouse. Typical birds are common egret, snowy egret, killdeer, marsh hawk, and mourning dove.

This soil is severely limited for urban and recreational development by low strength, high shrink-swell potential, and clayey texture. It is severely limited for septic tank absorption fields by the slow permeability.

This soil is in capability unit IIIs-3, irrigated, and capability subclass VIIs, nonirrigated.

9—Gilman loam. This deep, well drained, nearly level soil is on flood plains, alluvial fans, and low terraces. It formed in recent mixed alluvium. Elevation is 75 to 600 feet. The average annual precipitation ranges from 2 to 4 inches, the average annual air temperature ranges from 72 to 76 degrees F, and the average freeze-free period ranges from 250 to 325 days.

Typically, the surface layer is light yellowish brown and very pale brown loam about 15 inches thick. The underlying material to a depth of 60 inches or more is very pale brown very fine sandy loam and fine sandy loam. In places, the surface layer is fine sandy loam or very fine sandy loam.

Included with this soil in mapping are small areas of Vint loamy fine sand, Lagunita loamy sand, and Indio silt loam.

Permeability of this Gilman soil is moderate. Potential rooting depth is 60 inches or more. Available water capacity is high. Surface runoff is medium. The hazard of soil blowing is moderate. This soil normally is subject to rare flooding, but is now protected by dams or levees, or both, on the Colorado and Gila Rivers.

This soil is used mainly for irrigated alfalfa hay, citrus fruit, small grain, cotton, sugar beets, grain sorghum, bermudagrass, and vegetables.

If this soil is irrigated, it is suited to all adapted crops. All crops respond to nitrogen fertilizer, especially if a legume is not included in the cropping system. Phosphorus may be needed if alfalfa and other legumes are grown. Organic matter content, soil tilth, water intake rate, and other factors of soil condition can be maintained or improved by returning crop residue and adding manure to the soil. The risk of soil blowing can be reduced by growing a cover crop.

Irrigation water can be applied efficiently by using sprinkler, low pressure emitter, border, or furrow irrigation systems. Border and furrow systems are less efficient if all systems are operated at maximum potential. Border and furrow systems require land preparation. Among the suitable land preparation practices are leveling the soil and determining the proper length of runs and the proper width of borders. Water can be distributed by earth ditches, lined ditches, or pipelines. The moisture content of the soil should be determined before applying irrigation water, and then the correct amount of water should be applied at the right time. The amount of irrigation water applied should be measured to obtain high irrigation efficiency. Tailwater should be eliminated, or water recovery systems or pumpback systems, or both, should be used.

Irrigated areas of this soil have good potential for openland wildlife habitat and fair potential for wetland wildlife habitat. Typical mammals on this soil are valley pocket gopher and deer mouse. Typical birds are meadowlark, marsh hawk, common egret, killdeer, and mourning dove.

This soil is moderately limited for urban development because of low strength and for recreational development because of blowing dust. It is moderately limited for septic tank absorption fields because of moderate permeability and the hazard of contaminating the ground water supply. In populated areas, central sewage systems may be needed to prevent this contamination.

This soil is in capability unit I-1, irrigated, and capability subclass VIIc, nonirrigated.

10—Glenbar silty clay loam. This deep, well drained, nearly level soil is on flood plains and low terraces. It formed in recent mixed alluvium. Elevation is 76 to 600 feet. The average annual precipitation ranges from 2 to 4 inches, the average annual air temperature ranges from 72 to 76 degrees F, and the average freeze-free period ranges from 250 to 325 days.

Typically, the surface layer is pale brown and brown silty clay loam about 16 inches thick. The underlying material to a depth of 60 inches or more is light yellowish brown, pale brown, and very pale brown silty clay loam.

Included with this soil in mapping are small areas of Indio silt loam, Gilman loam, Vint loamy fine sand, and Gadsden clay.

Permeability of this Glenbar soil is moderately slow. Potential rooting depth is 60 inches or more. Available water capacity is high. Surface runoff is rapid. The hazard of soil blowing is moderate. This soil is normally subject to rare flooding, but it is now protected by dams or levees, or both, on the Colorado and Gila Rivers.

This soil is used for irrigated alfalfa hay, small grain, cotton, sugar beets, grain sorghum, vegetables, citrus fruit, and bermudagrass.

If this soil is irrigated, it is suited to all adapted crops. All crops respond to nitrogen fertilizer, especially if a legume is not included in the cropping system. Phosphorus may be needed if alfalfa and other legumes are grown. Organic matter content, soil tilth, water intake rate, and other factors of soil condition can be maintained or improved by returning crop residue and adding manure to the soil. The risk of soil blowing can be reduced by growing a cover crop.

Irrigation water can be applied efficiently by using sprinkler, low pressure emitter, border, or furrow irrigation systems. Border and furrow systems are less efficient if all systems operated at maximum potential. Border and furrow systems require land preparation. Among the suitable land preparation practices are leveling the soil and determining the proper length of runs and the proper width of borders. Water can be distributed by earth ditches, lined ditches, or pipelines. The moisture content of the soil should be determined before applying irrigation water, and then the correct amount of water should be applied at the right time. The amount of irrigation water applied should be measured to obtain high irrigation efficiency. Tailwater should be eliminated, or water recovery systems or pumpback systems, or both, should or used.

Irrigated areas of this soil have good potential for openland wildlife habitat and fair potential for wetland wildlife habitat. Typical mammals on this soil are valley pocket gopher and deer mouse. Typical birds are meadowlark, marsh hawk, common egret, snowy egret, killdeer, and mourning dove.

This soil is moderately limited for urban development because of moderate shrink-swell potential and low strength. It is slightly limited for recreational development. It is severely limited for septic tank absorption fields because of moderately slow permeability. In populated areas, central sewage systems may be needed to prevent contamination of the ground water supply.

This soil is in capability unit I-1, irrigated, and capability subclass VIIc, nonirrigated.

11—Harqua-Tremant complex. These deep, well drained, gently sloping soils are on old alluvial fans and low terraces. The soils formed in mixed old alluvium. Elevation is 400 to 1,200 feet. The average annual precipitation ranges from 2 to 4 inches, the average annual air temperature ranges from 72 to 76 degrees F, and the average freeze-free period ranges from 250 to 325 days.

The Harqua soil makes up about 45 percent of this complex and the Tremant soil about 40 percent. The Tremant soil is similar to the Harqua soil, but it is nonsaline. Carrizo very gravelly sand, Rositas sand, and Antho sandy loam make up the remaining 15 percent of this complex.

Typically, the Harqua soil has a surface layer of light brown gravelly loam about 5 inches thick. The subsoil to a depth of 60 inches or more is yellowish red gravelly clay loam and brown and reddish brown clay loam.

Permeability of the Harqua soil is moderately slow. Potential rooting depth is 60 inches or more. Available water capacity is limited by the salt content of the subsoil. Surface runoff is rapid, and the hazard of water erosion is slight.

Typically, the Tremant soil has a surface layer of light brown loam about 12 inches thick. The subsoil to a depth of 60 inches or more is brown and dark brown gravelly sandy clay loam and gravelly clay loam.

Permeability of the Tremant soil is moderately slow. Potential rooting depth is 60 inches or more. Available water capacity is high. Surface runoff is medium, and the hazard of water erosion is slight.

These soils are used mainly for irrigated cotton, alfalfa hay, safflower, grapes, citrus fruit, small grain, and grain sorghum. They are also used for limited livestock grazing.

If these soils are irrigated, they are suited to all adapted crops. All crops respond to nitrogen fertilizer, especially if a legume is not included in the cropping system. Phosphorus may be needed if alfalfa and other legumes are grown. Organic matter content, soil tilth, water intake rate, and other factors of soil condition can be maintained or improved by returning crop residue and adding manure to the soil. Permeability of these soils can be maintained or improved by adding extra amounts of organic matter to the soil and by growing deep-rooted plants. Deep chiseling or subsoiling can also be used, but the beneficial effect is temporary.

Irrigation water can be applied efficiently by using sprinkler, low pressure emitter, basin, border, or furrow irrigation systems. Border and furrow systems are less efficient than low pressure emitter systems if all systems are operated at maximum potential. Border and furrow systems require land preparation. Among the suitable land preparation practices are leveling the soil and determining the proper length of runs and the proper width of borders. Water can be distributed by earth ditches, lined ditches, or pipelines. The moisture content of the soil should be determined before applying irrigation water, and then the correct amount of water should be applied at the right time. The amount of irrigation water applied should be measured to obtain high irrigation efficiency. Tailwater should be eliminated, or water recovery systems or pumpback systems, or both, should be used.

To reduce the content of toxic salts, adding of soil amendments and leaching are needed periodically. Suitable soil amendments are sulfur, gypsum, and sulfuric acid. The amount of water needed for leaching varies with the concentration and kind of salts in the soil. Border irrigation is most effective for leaching. Disposal of drain water is difficult is most areas.

The potential plant community on the Harqua soil is mainly turkshead and on the Tremant soil is mainly white bursage, triangle bursage, and creosotebush. The includ-

ed soils in this unit produce most of the vegetation. Very little vegetation is in areas where desert pavement occurs. This unit should be managed for the included soils.

These soils have poor potential for livestock grazing.

Nonirrigated areas of this complex have poor potential for openland wildlife habitat and fair potential for wetland wildlife habitat. Water development is one of the most important practices needed when managing the soils for wildlife habitat. Irrigated areas have fair potential for openland and wetland wildlife habitat. Typical mammals on these soils are black-tailed jackrabbit, round-tailed ground squirrel, and Yuma antelope squirrel. Typical reptiles are collared lizard, desert spiny lizard, and desert side-blotched lizard.

These soils are moderately limited for urban development because of the shrink-swell potential and low strength and are severely limited for septic tank absorption fields because of the moderately slow permeability. They are moderately limited for recreational development because of the gravel content and moderately slow permeability.

These soils are in capability unit IIIs-9, irrigated, and capability subclass, VIIs, nonirrigated.

12—Holtville clay. This deep, well drained, nearly level soil is on flood plains. It formed in mixed alluvium. Elevation is 75 to 600 feet. The average annual precipitation ranges from 2 to 4 inches, the average annual temperature ranges from 72 to 76 degrees F, and the average freeze-free period ranges from 250 to 325 days.

Typically, the surface layer is pale brown clay about 13 inches thick. The upper part of the underlying material is pale brown clay about 10 inches thick. To a depth of 75 inches or more is stratified, very pale brown and light yellowish brown very fine sandy loam and silty clay loam. Depth to the very fine sandy loam underlying material ranges from 20 to 36 inches.

Included with this soil in mapping are small areas of Gadsden clay, Rositas sand, and Kofa clay.

Permeability of this Holtville soil is slow in the clay layer and moderate in the underlying material. Potential rooting depth is 60 inches or more. Available water capacity is high. Surface runoff is rapid, and the hazard of water erosion is slight.

This soil is used for irrigated cotton, alfalfa hay, grain sorghum, bermudagrass, sugar beets, vegetables, and small grain.

If this soil is irrigated, it is suited to all adapted crops. All crops respond to nitrogen fertilizer, especially if a legume is not included in the cropping system. Phosphorus may be needed if alfalfa and other legumes are grown. Organic matter content, soil tilth, water intake rate, and other factors of soil condition can be maintained or improved by returning crop residue and adding manure to the soil. Permeability of the soil can be maintained or improved by adding extra amounts of organic matter to the soil and by growing deep-rooted plants. Deep chiseling or subsoiling can also be used, but the beneficial effect is temporary.

Irrigation water can be applied efficiently by using sprinkler, low pressure emitter, basin, border, or furrow irrigation systems. Border and furrow systems are less efficient if all systems are operated at maximum potential. Border and furrow systems require land preparation. Among the suitable land preparation practices are leveling the soil and determining the proper length of runs and the proper width of borders. Water can be distributed by earth ditches, lined ditches, and pipelines. The moisture content of the soil should be determined before applying irrigation water, and then the correct amount of water should be applied at the right time. The amount of irrigation water applied should be measured to obtain high irrigation efficiency. Tailwater should be eliminated, or water recovery systems or pumpback systems, or both, should be used.

The potential of irrigated areas of this soil is good for openland wildlife habitat and poor for wetland wildlife habitat. The clay texture limits the growth of plants suitable for wildlife habitat, and seepage losses limit the development of shallow water areas. A suitable management practice is to plant or to leave woody vegetation along the field borders. Wildlife species that commonly use habitat provided by this soil include meadowlark, marsh hawk, valley pocket gopher, mourning dove, and deer mouse.

This soil is severely limited for urban and recreational development because of high clay content, shrink-swell potential, and low strength. This soil is severely limited for septic tank absorption fields because of slow permeability and for sewage lagoons because of seepage in the underlying material. In populated areas, especially where septic tank absorption fields may be buried below the clay layer, central sewage systems may be needed to prevent contamination of the ground water supply.

The soil is in capability unit IIIs-3, irrigated, and capability subclass VIIs, nonirrigated.

13—Indio silt loam. This deep, well drained, nearly level soil is on flood plains and alluvial fans. It formed in mixed alluvium. Elevation is 75 to 600 feet. The average annual precipitation ranges from 2 to 4 inches, the average annual air temperature ranges from 72 to 76 degrees F, and the average freeze-free period ranges from 250 to 325 days.

Typically, the surface layer is light brown silt loam about 6 inches thick. The underlying material to a depth of 60 inches or more is stratified, light brown very fine sandy loam to silt. In some places the surface layer is very fine sandy loam.

Included with this soil in mapping are small areas of Glenbar silty clay loam, Gilman loam, and Ripley silt loam.

Permeability of this Indio soil is moderate. Potential rooting depth is 64 inches or more. Available water capacity is high. Surface runoff is medium, and the hazard of water erosion is slight.

This soil is used for irrigated alfalfa hay, small grain, cotton, sugar beets, grain sorghum, citrus fruit, vegetables, and bermudagrass (fig. 4).

If this soil is irrigated, it is suited to all adapted crops. All crops respond to nitrogen fertilizer, especially if a legume is not included in the cropping system. Phosphorus may be needed if alfalfa and other legumes are grown. Organic matter content, soil tilth, water intake rate, and other factors of soil condition can be maintained or improved by returning crop residue and adding manure to the soil.

Irrigation water can be applied efficiently by using sprinkler, low pressure emitter, border, or furrow irrigation systems. Border and furrow systems are less efficient if all systems are operated at maximum potential. Border and furrow systems require land preparation. Among the suitable land preparation practices are leveling the soil and determining the proper length of runs and the proper width of borders. Water can be distributed by earth ditches, lined ditches, or pipelines. The moisture content of the soil should be determined before applying irrigation water, and then the correct amount of water should be applied at the right time. The amount of irrigation water applied should be measured to obtain high irrigation efficiency. Tailwater should be eliminated, or water recovery systems or pumpback systems, or both, should be used.

Irrigated areas of this soil have good potential for openland wildlife habitat and poor potential for wetland wildlife habitat. A suitable management practice for use on this soil is to plant or to leave woody vegetation along the field borders. Typical species of wildlife on this soil are zebra-tailed lizard, Great Basin whiptail, western diamondback rattlesnake, coyote, badger, Yuma antelope squirrel, loggerhead shrike, mourning dove, and Gambel's quail.

This soil has slight limitations for sewage lagoons. It has slight limitations for urban development and moderate limitations for recreational development. In populated areas, central sewage systems may be needed to prevent contamination of the ground water supply.

This soil is in capability unit I-1, irrigated, and capability subclass VIIc, nonirrigated.

14—Indio silt loam, saline. This deep, well drained, saline soil is on flood plains and alluvial fans. It formed in mixed alluvium. Elevation is 76 to 600 feet. The average annual precipitation ranges from 2 to 4 inches, the average annual air temperature ranges from 72 to 76 degrees F, and the average freeze-free period ranges from 250 to 325 days.

Typically, the surface layer is pale brown silt loam about 12 inches thick over stratified very fine sandy loam to silt that extends to a depth of 60 inches or more. Thin strata of silty clay loam are in the lower part of the profile, and many fine salt crystals are throughout the profile. In some areas the surface layer is very fine sandy loam.

Included with this soil in mapping are small areas of Glenbar silty clay loam, Gilman loam, and Ripley silt loam.

Permeability of this Indio soil is moderate. Potential rooting depth is 60 inches or more. Available water capacity is limited because of the high concentration of salt. Surface runoff is moderate, and the hazard of water erosion is slight.

This soil is used for climatically adapted, salt-tolerant crops such as irrigated bermudagrass, alfalfa hay, and barley.

If this soil is irrigated, it is suited to all adapted crops. All crops respond to nitrogen fertilizer, especially if a legume is not included in the cropping system. Phosphorus may be needed if alfalfa and other legumes are grown. Organic matter content, soil tilth, water intake rate, and other factors of soil condition can be maintained or improved by returning crop residue and adding manure to the soil. Permeability of the soil can be maintained or improved by adding extra amounts of organic matter to the soil and by growing deep-rooted plants. Deep chiseling or subsoiling can also be used, but the beneficial effect is temporary.

Irrigation water can be applied efficiently by using sprinkler, low pressure emitter, basin, border, or furrow irrigation systems. Border and furrow systems are less efficient if all systems are operated at maximum potential. Border and furrow systems require land preparation. Among the suitable land preparation practices are leveling the soil and determining the proper length of runs and the proper width of borders. Water can be distributed by earth ditches, lined ditches, or pipelines. The moisture content of the soil should be determined before applying irrigation water, and then the correct amount of water should be applied at the right time. The amount of water applied should be measured to obtain high irrigation efficiency. Tailwater should be eliminated, or water recovery systems or pumpback systems, or both, should be used.

To reduce the content of toxic salts, adding soil amendments and leaching are needed periodically. Suitable soil amendments are sulfur, gypsum, and sulfuric acid. The amount of water needed for leaching varies with the concentration and kind of salts in the soil. Border irrigation is most effective for leaching. Disposal of drain water is difficult in most areas.

In irrigated areas the potential is good for openland wildlife habitat and fair for wetland wildlife habitat. Soil salinity limits the growth of plants suitable for wildlife habitat. Typical species of wildlife on this soil are western diamondback rattlesnake, horned lark, and coyote.

This soil is slightly limited for urban development and for septic tank absorption fields. In populated areas, central sewage systems may be needed to prevent contamination of the ground water supply. Dust is a moderate problem in recreational development.

This soil is in capability unit IIIs-9, irrigated, and capability subclass VIIs, nonirrigated.

15—Indio silt loam, strongly saline. This deep, well drained soil is on flood plains and alluvial fans. It formed in mixed alluvium. Elevation is 75 to 600 feet. The average annual precipitation ranges from 2 to 4 inches, the average annual air temperature ranges from 72 to 76 degrees F, and the average freeze-free period ranges from 250 to 325 days.

Typically, the surface layer is light brown and pink silt loam about 4 inches thick. The underlying material to a depth of 60 inches or more is light brown silt loam that is highly stratified with thin layers of silt, silty clay loam, and very fine sandy loam. In nonirrigated areas, the surface commonly has a thin white salt crust because of the upward capillary movement of water and evaporation (fig. 5). In other areas the surface layer is very fine sandy loam.

Included with this soil in mapping are small areas of Glenbar silty clay loam, Gilman loam, and Ripley silty loam.

Permeability of this Indio soil is moderate. Potential rooting depth is 60 inches or more. Available water capacity is limited because of the high concentration of salt. Surface runoff is medium, and the hazard of water erosion is slight.

This soil is used primarily as rangeland, but small areas are used for climatically adapted, salt-tolerant crops such as irrigated bermudagrass, alfalfa hay, and barley.

If this soil is irrigated, it is suited to all adapted crops. All crops respond to nitrogen fertilizer, especially if a legume is not included in the cropping system. Phosphorus may be needed if alfalfa and other legumes are grown. Organic matter content, soil tilth, water intake rate, and other factors of soil condition can be maintained or improved by returning crop residue and adding manure to the soil. Permeability of the soil can be maintained or improved by adding extra amounts of organic matter to the soil and by growing deep-rooted plants. Deep chiseling or subsoiling can also be used, but the beneficial effect is temporary.

Irrigation water can be applied efficiently by using sprinkler, low pressure emitter, basin, border, or furrow irrigation systems. Border and furrow systems are less efficient if all systems are operated at maximum potential. Border and furrow systems require land preparation. Among the suitable land preparation practices are leveling the soil and determining the proper length of runs and the proper width of borders. Water can be distributed by earth ditches, lined ditches, or pipelines. The moisture content of the soil should be determined before applying irrigation water, and then the correct amount of water should be applied at the right time. The amount of irrigation water applied should be measured to obtain high irrigation efficiency. Tailwater should be eliminated, or water recovery systems or pumpback systems, or both, should be used.

To reduce the content of toxic salts, adding soil amendments and leaching are needed periodically. Suitable soil amendments are sulfur, gypsum, and sulfuric acid. The amount of water needed for leaching varies with the concentration and kind of salts in the soil. Leaching of salts requires adequate internal or artificial drainage. Border irrigation is most effective for leaching.

The potential plant community is mainly saltcedar, mesquite, and allscale saltbush. Unpalatability of the native vegetation and lack of livestock watering facilities severely limit the use of this soil for livestock grazing. The hazard of soil blowing is moderate if the native plant cover is not preserved. Windbreaks and other kinds of cover help to control soil blowing.

Irrigated areas of this soil have very poor potential for openland and wetland wildlife habitat. Soil salinity limits the growth of plants suitable for wildlife habitat. Typical species of wildlife on this soil are western diamondback rattlesnake, horned lark, and coyote.

This soil is slightly limited for urban development. It is moderately limited for septic tank absorption fields because of moderate permeability. In populated areas, central sewage systems may be needed to prevent contamination of the ground water supply. The soil is moderately limited for recreational development because of the hazard of soil blowing.

This soil is in capability unit IVs-9, irrigated, and capability subclass VIIs, nonirrigated.

16—Indio-Lagunita-Ripley complex. These nearly level to gently sloping soils are on flood plains, alluvial fans, and low terraces and in drainageways along the Gila and Colorado Rivers. The soils formed in recent mixed alluvium. Elevation is 100 to 500 feet. The average annual precipitation ranges from 2 to 4 inches, the average annual air temperature ranges from 72 to 76 degrees F, and the average freeze-free period ranges from 250 to 325 days.

The Indio soil makes up about 35 percent of this complex, the Lagunita soil about 25 percent, and the Ripley soil about 25 percent. The Lagunita soil is coarse textured throughout the profile. The Ripley soil is similar to the Indio soil, but it is coarse textured in the lower part of the profile. Glenbar silty clay loam and Vint loamy fine sand make up the remaining 15 percent of this complex.

Typically, the well drained Indio soil has a surface layer of light brown silt loam about 6 inches thick. The underlying material to a depth of 63 inches or more is

light brown, stratified very fine sandy loam to silt. In some places the surface layer is very fine sandy loam.

Permeability of the Indio soil is moderate. Potential rooting depth is 63 inches or more. Available water capacity is high. Surface runoff is medium, and the hazard of water erosion is slight. This soil is subject to rare flooding.

Typically, the somewhat excessively drained Lagunita soil has a surface layer of pale brown loamy sand about 8 inches thick. The underlying material to a depth of 60 inches or more is pale brown loamy sand. In some places the surface layer is sand.

Permeability of the Lagunita soil is rapid. Potential rooting depth is 60 inches or more. Available water capacity is low. Surface runoff is slow. This soil is subject to rare flooding.

Typically, the well drained Ripley soil has a surface layer of light brown silt loam about 6 inches thick. The upper part of the underlying material, about 19 inches thick, is pale brown very fine sandy loam that has numerous thin strata of very fine sand, silt, and silt loam. The lower part to a depth of 60 inches or more is pale brown sand.

Permeability of the Ripley soil is moderate in the upper part and rapid in the underlying material. Potential rooting depth is 60 inches or more. Available water capacity is moderate. Surface runoff is medium, and the hazard of water erosion is slight.

These soils are suited to irrigated farming if they are extensively cleared and leveled. Some areas are used for irrigated crops or as homesites.

The vegetation on the Indio soil is mainly saltcedar, mesquite, and arrowweed; on the Lagunita soil it is mainly arrowweed, fourwing saltbush, and mesquite; and on the Ripley soil it is mainly arrowweed, mesquite, and annual forbs.

This complex has the highest total production of native plants in the survey area, but only a small amount of the vegetation is palatable to livestock. It is valuable to livestock for shade and because of its proximity to water. Because this complex is along stream bottoms and terraces that are subject to rare flooding, grazing management to maintain the plant cover is important. Protection of these areas from overgrazing and fire and maintenance of the brush are key management considerations.

This complex has very poor potential for openland and wetland wildlife habitat and poor potential for rangeland wildlife habitat. The complex supports one of the most important habitat types in the survey area. The habitat includes riparian, or streambank, plant communities. It commonly includes an overstory of large deciduous trees such as cottonwood and an understory of smaller shrubs and grasses. Many species of bird use the large overstory trees for nesting. Among these species are Cooper's hawk, Gila woodpecker, ladderbacked woodpecker, western kingbird, ash-throated flycatcher, oriole, and house finch. Some species use the understory for nesting. Examples of these species are killdeer, mourning dove, white-winged dove, Gambel's quail, and Abert's towhee. Typical mammals on this complex are desert cottontail, valley pocket gopher, raccoon, muskrat, and gray fox. Typical reptiles and amphibians are Great Plains toad, bullfrog, western whiptail, glossy snake, and Arizona king snake.

These soils are severely limited for most urban development and are moderately limited for recreational development because of the hazard of flooding and the blowing of sand and dust. They are severely limited for septic tank absorption fields because of the hazard of flooding. In populated areas, a central sewage system may be needed to prevent contamination of the ground water supply.

This complex is in capability unit IVs-7, irrigated, and capability subclass VIIs, nonirrigated.

17—Kofa clay. This deep, well drained, nearly level soil is on low stream terraces and flood plains. It formed in recent mixed alluvium. Elevation is 75 to 600 feet. The average annual precipitation ranges from 2 to 4 inches, the average annual air temperature ranges from 72 to 76 degrees, and the average freeze-free period ranges from 250 to 325 days.

Typically, the surface layer is pale brown clay about 12 inches thick. The upper part of the underlying material is pale brown clay about 16 inches thick over very pale brown sand that extends to a depth of 60 inches or more. In some places the surface layer is sandy clay.

Included with this soil in mapping are small areas of Gadsden clay, Holtville clay, Glenbar silty clay loam, and Indio silt loam.

Permeability of this Kofa soil is slow in the upper part of the profile and rapid in the lower part. Potential rooting depth is 60 inches or more. Available water capacity is moderate. Most of the available water is in the clay layer. Surface runoff is rapid, and the hazard of water erosion is slight. This soil is normally subject to rare flooding, but now it is protected by dams or levees, or both, on the Colorado and Gila Rivers.

This soil is used mainly for irrigated grain sorghum, cotton, alfalfa hay, bermudagrass, sugar beets, vegetables, and small grain (figs. 6 and 7).

If this soil is irrigated, it is suited to all adapted crops. All crops respond to nitrogen fertilizer, especially if a legume is not included in the cropping system. Phosphorus may be needed if alfalfa and other legumes are grown. Organic matter content, soil tilth, water intake rate, and other factors of soil condition can be maintained or improved by returning crop residue and adding manure to the soil. Permeability of the soil can be maintained or improved by adding extra amounts of organic matter to the soil and by growing deep-rooted plants. Deep chiseling or subsoiling can also be used, but the beneficial effect is temporary.

Irrigation water can be applied efficiently by using sprinkler, low pressure emitter, basin, border, and furrow irrigation systems. Border and furrow systems are less efficient if all systems are operated at maximum potential. Border and furrow systems require land preparation. Among the suitable land preparation practices are leveling the soil and determining the proper length of runs and the proper width of borders. Water can be distributed by earth ditches, lined ditches, or pipelines. The moisture content of the soil should be determined before applying irrigation water, and then the correct amount of water should be applied at the right time. The amount of irrigation water applied should be measured to obtain high irrigation efficiency. Tailwater should be eliminated, or water recovery systems or pumpback systems, or both, should be used.

In irrigated areas the potential is fair for openland wildlife habitat and very poor for wetland wildlife habitat. The clayey texture of the upper part of this soil limits the growth of wild herbaceous plants. Typical species of wildlife on this soil are common egret, snowy egret, killdeer, marsh hawk, valley pocket gopher, deer mouse, and diamondback rattlesnake. Management for wildlife habitat on this soil should include planting or leaving woody vegetation along field borders.

This soil is severely limited for urban and recreational development because of the high clay content. It is slightly limited for septic tank absorption fields. In populated areas, central sewage systems may be needed to prevent contamination of the ground water supply. This soil is slightly limited for urban development if building foundations, slabs, and footings are placed below the clay layer.

This soil is in capability unit IIIs-3, irrigated, and capability subclass VIIs, nonirrigated.

18—Lagunita loamy sand. This deep, somewhat excessively drained, nearly level soil is on flood plains, low terraces, and alluvial fans and in drainageways. It formed in recent alluvium. Elevation is 75 to 600 feet. The average annual precipitation ranges from 2 to 4 inches, the average annual air temperature ranges from 72 to 76 degrees F, and the average freeze-free period ranges from 250 to 325 days.

Typically, the surface layer is pale brown loamy sand about 8 inches thick. The underlying material to a depth of 60 inches or more is pale brown loamy sand. In some places the surface layer is sand.

Included with this soil in mapping are small areas of Carrizo very gravelly sand, Antho sandy loam, and Antho fine sandy loam.

Permeability of this Lagunita soil is rapid. Potential rooting depth is 60 inches or more. Available water capacity is low. Surface runoff is slow. The hazard of soil blowing is high. This soil normally is subject to rare flooding, but it is now protected by dams or levees, or both, on the Colorado and Gila Rivers.

This soil is used mainly for irrigated citrus fruit, alfalfa hay, and small grain. Small areas are used for livestock grazing.

If this soil is irrigated, it is suited to all adapted crops. All crops respond to nitrogen fertilizer, especially if a legume is not included in the cropping system. Phosphorus may be needed if alfalfa and other legumes are grown. Organic matter content, soil tilth, water intake rate, and other factors of soil condition can be maintained or improved by returning crop residue and adding manure to the soil. The risk of soil blowing can be reduced by growing a cover crop.

Irrigation water can be applied efficiently by using sprinkler, low pressure emitter, or furrow irrigation systems. Furrow systems are less efficient if all systems are operated at maximum potential. Furrow systems require land preparation. Among the suitable land preparation practices are leveling the soil and determining the proper length of runs. Water can be distributed by lined ditches or pipelines. Special designs for sprinklers and emitters are needed. The moisture content of the soil should be determined before applying irrigation water, and then the correct amount of water should be applied at the right time. The amount of irrigation water applied should be measured to obtain high irrigation efficiency. Light, frequent applications of water are essential. Tailwater should be eliminated, or water recovery systems or pumpback systems, or both, should be used.

The native plant community consists of arrowweed, fourwing saltbush, mesquite, and desert saltbush.

Livestock grazing is severely limited by the shortage of watering facilities. Because of the high hazard of soil blowing, management of vegetation should be designed to maintain the plant cover.

Irrigated areas of this soil have good potential for openland wildlife habitat and very poor potential for wetland wildlife habitat (fig. 8). Typical reptiles on this soil are desert iguana, zebra-tailed lizard, western diamondback rattlesnake, and sidewinder. Typical mammals are Yuma antelope squirrel, desert kangaroo rat, and desert cottontail rabbit. Typical birds are mourning dove, Gambel's quail, and various nongame birds.

This soil is slightly limited for urban development and moderately limited for recreational development because of the sandy texture. It is slightly limited for septic tank absorption fields. In populated areas, central sewage systems may be needed to prevent the contamination of the ground water supply.

This soil is in capability unit IVs-7, irrigated, and capability subclass VIIs, nonirrigated.

19—Lagunita silt loam. This deep, somewhat excessively drained, nearly level soil is on flood plains, low terraces, and low alluvial fans and in drainageways. It formed in recent alluvium. Elevation is 100 to 600 feet. The average annual precipitation ranges from 2 to 4 inches, the average annual air temperature ranges from

72 to 76 degrees F, and the average freeze-free period ranges from 250 to 325 days.

Typically, the surface layer is light brown silt loam about 12 inches thick. The underlying material to a depth of 60 inches or more is reddish yellow and pinkish gray loamy fine sand and sand. In some places the surface layer is silt.

Included with this soil in mapping are small areas of Vint loamy fine sand, Ripley silt loam, Glenbar silty clay loam, and Indio silt loam.

Permeability of this Lagunita soil is rapid. Potential rooting depth is 60 inches or more. Available water capacity is low. Surface runoff is moderate. The hazard of soil blowing is moderate. This soil is normally subject to rare flooding, but it is now protected by dams or levees, or both, on the Colorado and Gila Rivers.

This soil is used mainly for irrigated citrus fruit, alfalfa hay, small grain, cotton, and vegetables. Small areas are used for limited livestock grazing.

If this soil is irrigated, it is suited to all adapted crops. All crops respond to nitrogen fertilizer, especially if a legume is not included in the cropping system. Phosphorus may be needed if alfalfa and other legumes are grown. Organic matter content, soil tilth, water intake rate, and other factors of soil condition can be maintained or improved by returning crop residue and adding manure to the soil. The risk of soil blowing can be reduced by growing a cover crop.

Irrigation water can be applied efficiently by using sprinkler, low pressure emitter, or furrow irrigation systems. Furrow systems are less efficient if all systems are operated at maximum potential. Furrow systems require land preparation. Among the suitable land preparation practices are leveling the soil and determining the proper length of runs. Water can be distributed by lined ditches and pipelines. Special design of sprinklers and emitters are needed. The moisture content of the soil should be determined before applying irrigation water, and then the correct amount of water should be applied at the right time. The amount of irrigation water applied should be measured to obtain high irrigation efficiency. Light, frequent applications of water are essential. Tailwater should be eliminated, or water recovery systems or pumpback systems, or both, should be used.

The native vegetation is mainly arrowweed, fourwing saltbush, mesquite, and desert saltbush.

Nonirrigated areas of this soil have poor potential for rangeland wildlife habitat. Irrigated areas have good potential for openland wildlife habitat and very poor potential for wetland wildlife habitat. Typical reptiles on this soil are desert iguana, zebra-tailed lizard, western diamondback rattlesnake, and sidewinder. Typical mammals are desert cottontail rabbit and valley pocket gopher. Typical birds are mourning dove, white-winged dove, loggerhead shrike, Gambel's quail, and various other nongame birds.

This soil is slightly limited for urban development and moderately limited for recreational development because of blowing dust. It is slightly limited for septic tank absorption fields. In populated areas, central sewage systems may be needed to prevent contamination of the ground water supply.

This soil is in capability unit IIIs-7, irrigated, and capability subclass VIIs, nonirrigated.

20—Laposa-Rock outcrop complex, 15 to 75 percent slopes. This complex is on the Trigo Mountains and on hills scattered throughout the survey area. Elevation is 400 to 2,000 feet. The average annual precipitation ranges from 2 to 4 inches, the average annual air temperature ranges from 72 to 76 degrees F, and the average freeze-free period ranges from 250 to 325 days.

The Laposa soil makes up about 55 percent of this complex and Rock outcrop about 25 percent. Rock outcrop is scattered throughout areas of the Laposa soil. Carrizo very gravelly sand, Gachado very gravelly loam, and Cristobal very gravelly loam make up the remaining 20 percent of this complex.

The Laposa soil is moderately deep and well drained. It formed in extremely gravelly residuum. Typically, 70 to 80 percent of the surface is covered with pebbles and cobbles. The surface layer is yellowish brown extremely gravelly loam about 3 inches thick. The underlying material is light yellowish brown extremely gravelly loam about 29 inches thick. Extremely hard granitic bedrock is at a depth of 32 inches.

Permeability of the Laposa soil is moderate. Potential rooting depth is 20 to 40 inches. Available water capacity is low. Surface runoff is rapid.

Rock outcrop consists of exposed areas of granite, gneiss, schist, andesite, and rhyolite. Runoff is rapid.

This complex is used as watershed and as open space.

The potential plant community is mainly creosotebush, white bursage, and ocotillo. Because of the steep terrain and the low palatability of the native plants, this complex is poorly suited to livestock grazing (fig. 9). It should be maintained in its present plant cover.

This complex has very poor potential for rangeland wildlife habitat. The many crevices in the Rock outcrop on this complex provide places for birds and animals to rest, nest, and raise their young. The areas of Rock outcrop also serve as hunting perches for birds of prey. Birds such as the red-tailed hawk, owls, swallows, and wrens commonly use these areas. Large rocks offer places for reptiles such as the Arizona chuckwalla to display during breeding. Other reptiles commonly present on this complex are spiny lizard, western black-headed snake, and western diamondback rattlesnake. Typical mammals are bats, woodrats, Yuma antelope squirrel, and bobcat. Development of water catchments is one of the more important management practices that can be used on this complex.

This complex has very poor potential for farming, sanitary facilities, community development, and recreational facilities because of excessive slope, the extremely gravelly surface, and the presence of bedrock within 20 to 40 inches of the surface.

This complex is in capability subclass VIIs, nonirrigated.

21—Ligurta-Cristobal complex, 2 to 6 percent slopes. These deep, well drained, strongly saline soils are on old alluvial fans and low terraces in the eastern part of the survey area and along the Colorado River. These soils formed in mixed old alluvium. Elevation ranges from 250 to 1,300 feet. The average annual precipitation ranges from 2 to 4 inches, the average annual air temperature ranges from 72 to 76 degrees F, and the average freeze-free period ranges from 250 to 325 days.

The Ligurta soil makes up about 50 percent of this complex and the Cristobal soil about 35 percent. The Cristobal soil is similar to the Ligurta soil but is 30 to 90 percent coarse fragments. Tremant gravelly loam, Antho sandy loam, Carrizo very gravelly sand, and small areas of calcareous, very gravelly loams make up the remaining 15 percent.

Typically, the Ligurta soil has a surface layer of very pale brown very gravelly loam about 2 inches thick. The subsoil to a depth of 60 inches or more is reddish yellow, yellowish red, and light reddish brown gravelly clay loam, gravelly loam, and clay loam. In places the surface layer is very gravelly clay loam, very gravelly sandy clay loam, or very gravelly sandy loam.

Permeability of the Ligurta soil is moderately slow. Potential rooting depth is 60 inches or more. Available water capacity is only moderate because of the high content of salts in the soil. Surface runoff is rapid, and the hazard of water erosion is slight.

Typically, the Cristobal soil has a surface layer of pale brown very gravelly loam about 2 inches thick. The subsoil to a depth of 60 inches or more is red, yellowish red, reddish yellow, and light brown very gravelly clay loam, gravelly clay loam, extremely gravelly clay loam, and very gravelly sandy clay loam.

Permeability of the Cristobal soil is moderately slow. Potential rooting depth is 60 inches or more. Available water capacity is only moderate because of the high content of salts in the soil. Surface runoff is rapid, and the hazard of water erosion is slight.

These soils are used for limited livestock grazing.

The potential plant community on the Ligurta soil is mainly creosotebush, turkshead, and Indianwheat; on the Cristobal soil it is mainly creosotebush, saguaro, and turkshead. The included soils in this unit produce most of the vegetation; therefore, the unit should be managed for the included soils.

Unpalatability of forage and lack of watering facilities are severe limitations of livestock grazing.

These soils have very poor potential for rangeland and wetland wildlife habitat. Water development is one of the more important practices that can be used to manage these soils for wildlife habitat. Typical reptiles on the soils are zebra-tailed lizard, Great Basin whiptail, and western diamondback rattlesnake. Typical mammals are coyote and mule deer. Typical birds are verdin and horned lark.

These soils are moderately limited for urban development because of shrink-swell potential and are severely limited for recreational development because of the gravel content. They are severely limited for septic tank absorption fields because of moderately slow permeability. The desert pavement on these soils helps to control soil blowing (fig. 10).

This complex is in capability subclass VIIs, nonirrigated.

22—Pits, borrow. This unit consists of areas where the upper layers of soil material have been removed. Some areas were used as sources of fill material during the construction of Interstate 8. The areas of this unit are 3 to 20 feet deep.

Borrow pits are well suited to use for waste disposal. Where soils that are suitable as a source of cover material are available, and where the water table is not high, this unit is well suited to sanitary landfill operations.

This unit provides some wildlife habitat. In areas where the water table is high, small ponds are present, at least seasonally. These areas support warm-water fish, frogs, muskrats, and waterfowl. The edges of these areas support a rich growth of cattails, saltcedar, mesquite, and arrowweed. In areas where the water table is at a greater depth, and that are filled only intermittently as a result of runoff from surrounding areas, the herbs and shrubs grow better than in the surrounding areas.

Areas of this unit can be graded or filled and reclaimed for farming or for urban use.

This unit is not placed in a capability subclass.

23—Pits, gravel. This unit consists of areas where the upper layers of soil material have been removed to expose the gravelly material. With the exception of large commercial operations, these areas are 6 to 10 feet deep. The unit occurs in and adjacent to drainageways and along the Colorado and Gila Rivers.

The gravel is primarily used for protecting the streambed along the Colorado River, for protecting roads in the sandy areas on the Yuma Mesa, and for construction in the survey area.

This unit is used for recreation and wildlife habitat. Some areas have been dozed out, leaving wide bottoms for water storage. Except in areas near permanent water, the edges support very little vegetation. Most pits are filled with water only intermittently as a result of runoff from surrounding areas or during rare floods. Reclama-

tion of other areas for recreation and wildlife habitat is planned.

This unit is not placed in a capability subclass.

24—Ripley silt loam. This deep, well drained, nearly level soil is on flood plains and low terraces. It formed in mixed alluvium. Elevation is 75 to 600 feet. The average annual precipitation ranges from 2 to 4 inches, the average annual air temperature ranges from 72 to 76 degrees F, and the average freeze-free period ranges from 250 to 325 days.

Typically, the surface layer is light brown silt loam about 6 inches thick. The upper 19 inches of the underlying material is pale brown very fine sandy loam that has a few thin strata of very fine sand, silt, and silt loam. The lower part to a depth of 60 inches or more is pale brown sand.

Included with this soil in mapping are small areas of Glenbar silty clay loam, Indio silt loam, Gilman loam, and Lagunita loamy sand.

Permeability of this Ripley soil is moderate in the upper part and rapid in the lower part. Potential rooting depth is 60 inches or more. Available water capacity is moderate. Most of the available water is in the upper 25 inches of the profile. Surface runoff is medium, and the hazard of water erosion is slight. The hazard of soil blowing is moderate.

This soil is used mainly for irrigated cotton, citrus fruit, alfalfa hay, small grain, grain sorghum, and vegetables.

If this soil is irrigated, it is suited to all adapted crops. All crops respond to nitrogen fertilizer, especially if a legume is not included in the cropping system. Phosphorus may be needed if alfalfa and other legumes are grown. Organic matter content, soil tilth, water intake rate, and other factors of soil condition can be maintained or improved by returning crop residue and adding manure to the soil. The risk of soil blowing can be reduced by growing a cover crop.

Irrigation water can be applied efficiently by using sprinkler, low pressure emitter, border, or furrow irrigation systems. Border and furrow systems are less efficient if all systems are operated at maximum potential. Border and furrow systems require land preparation. Among the suitable land preparation practices are leveling the soil and determining the proper length of runs and the proper width of borders. Water can be distributed by earth ditches, lined ditches, or pipelines. The moisture content of the soil should be determined before applying irrigation water, and then the correct amount of water should be applied at the right time. The amount of irrigation water applied should be measured to obtain high irrigation efficiency. Tailwater should be eliminated, or water recovery systems or pumpback systems, or both, should be used.

The native vegetation on this soil is mainly arrowweed, fourwing saltbush, mesquite, and annual forbs.

This soil produces a relatively large amount of native vegetation, but it has moderate limitations for livestock grazing because of the variability of production. The hazard of soil blowing is moderate if the native plant cover is not preserved. Windbreaks and other kinds of cover help to control soil blowing. The vegetation should be managed to maintain the native vegetation.

In irrigated areas, the potential for openland wildlife habitat is good and the potential for wetland wildlife habitat is poor. Typical species of wildlife on this soil are zebra-tailed lizard, Great Basin whiptail, western diamondback rattlesnake, coyote, badger, Yuma antelope squirrel, loggerhead shrike, mourning dove, and Gambel's quail.

Nonirrigated areas of this soil have poor potential for rangeland wildlife habitat. Management for wildlife habitat on this soil should include planting or leaving woody vegetation along field borders. Where the water table is high enough, potholes can be blasted to create standing water and produce vegetation suitable for wildlife.

This soil is slightly limited for urban development and moderately limited for recreational development because of blowing dust. It is slightly limited for septic tank absorption fields but is severely limited for sewage lagoons because of seepage. In populated areas, central sewage systems may be needed to prevent contamination of the ground water supply.

This soil is in capability unit IIs-7, irrigated, and capability subclass VIIs, nonirrigated.

25—Rositas sand. This deep, somewhat excessively drained, nearly level to rolling soil is on terraces, alluvial fans, and sand dunes. It formed in mixed, sandy, windblown material. Elevation ranges from 75 to 700 feet. The average annual precipitation ranges from 2 to 4 inches, the average annual air temperature ranges from 72 to 76 degrees F, and the average freeze-free period ranges from 250 to 325 days.

Typically, this soil is light brown sand to a depth of 60 inches or more.

Included with this soil in mapping are small areas of Superstition sand.

Permeability of this Rositas soil is rapid. Potential rooting depth is 60 inches or more. Available water capacity is low. Surface runoff is very slow. The hazard of soil blowing is high.

This soil is used mainly as range (fig. 11). Some small areas are used for irrigated crops.

If this soil is irrigated, it is suited to all adapted crops. All crops respond to nitrogen fertilizer, especially if a legume is not included in the cropping system. Phosphorus may be needed if alfalfa and other legumes are grown. Organic matter content, soil tilth, water intake rate, and other factors of soil condition can be maintained or improved by returning crop residue and adding manure to the soil. The risk of soil blowing can be

reduced by growing a cover crop or providing other kinds of protective cover.

Irrigation water can be applied efficiently by using sprinkler, low pressure emitter, or furrow irrigation systems. Furrow systems are less efficient if all systems are operated at maximum potential. Furrow systems require land preparation. Among the suitable land preparation practices are leveling the soil and determining the proper length of runs. Water can be distributed by lined ditches or pipelines. Special design of emitters and sprinklers is needed. The moisture content of the soil should be determined before applying irrigation water, and then the correct amount of water should be applied at the right time. The amount of irrigation water applied should be measured to obtain high irrigation efficiency. Light, frequent applications of water are essential. Tailwater should be eliminated, or water recovery systems or pumpback systems, or both, should be used.

The potential plant community on this soil is mainly big galleta, creosotebush, and primrose.

This soil produces more forage suitable for livestock than any other soil in the survey area. The lack of livestock watering facilities and the variability in the annual production of forage, however, limit the use of this soil for grazing. Because the hazard of soil blowing is high, grazing management that helps to maintain the plant cover is needed.

In irrigated areas this soil has very poor potential for openland and wetland wildlife habitat.

In nonirrigated areas the potential is very poor for rangeland wildlife habitat. Development of watering facilities, in the form of artificial catchments, is an important habitat management practice on this soil. Typical reptiles on the soil are desert iguana, sidewinder, and zebra-tailed lizard. Typical mammals are kangaroo rat, pocket mouse, and black-tailed jackrabbit.

This soil is severely limited for recreational development because of the texture. It is moderately limited for urban development and septic tank absorption fields because of slope. It is severely limited for sewage lagoons because of seepage. In populated areas, central sewage systems may be needed to prevent contamination of the ground water supply.

This soil is in capability unit IVs-7, irrigated, and capability subclass VIIs, nonirrigated.

26—Rositas-Ligurta complex. This complex consists of deep, gently sloping soils on low terraces and sand dunes. Elevation ranges from 200 to 400 feet. The average annual precipitation ranges from 2 to 4 inches, the average annual air temperature ranges from 72 to 76 degrees F, and the average freeze-free period ranges from 250 to 325 days.

The Rositas soil makes up about 55 percent of this complex and the Ligurta soil about 30 percent. Superstition sand makes up the remaining 15 percent.

The Rositas soil is somewhat excessively drained. It formed on dunes of wind-deposited material. Typically, the Rositas soil is light brown sand to a depth of 60 inches or more.

Permeability of the Rositas soil is rapid. Potential rooting depth is 60 inches or more. Available water capacity is low. Surface runoff is very slow, and the hazard of water erosion is slight. The hazard of soil blowing is high.

The Ligurta soil is well drained and saline. It formed in alluvium. Typically, the surface layer is very pale brown very gravelly loam about 2 inches thick. The subsoil to a depth of 60 inches or more is reddish yellow, yellowish red, and light reddish brown gravelly clay loam, gravelly loam, and clay. In some places the surface layer is very gravelly clay loam, very gravelly sandy clay loam, or very gravelly sandy loam.

Permeability of the Ligurta soil is moderately slow. Potential rooting depth is 60 inches or more. Available water capacity is limited because of the high salt content. Surface runoff is medium, and the hazard of water erosion is slight.

These soils are used mainly as range.

If these soils are irrigated, they are suited to all adapted crops. Applications of commercial fertilizers are needed in addition to plant residue. Border, drip, and sprinkler irrigation systems are suitable for use on these soils. The system used is generally governed by the crop. Water must be applied in accordance with the intake rate of the soil.

The potential plant community on the Rositas soil is mainly creosotebush, primrose, and big galleta. The potential plant community on the Ligurta soil is mainly white bursage, creosotebush, Indianwheat, and turkshead.

Livestock grazing on this complex is limited mainly by the wide variability in the production of forage. Lack of livestock watering facilities also limits use. Grazing should be managed to minimize the disturbance of the native plant cover. The included soils in this unit produce most of the vegetation; therefore, the unit should be managed for the included soils.

The potential for wetland and rangeland wildlife habitat is very poor. The high content of soluble salt in the Ligurta soil and the great difference in the soil drainage of the two soils account for the wide variety of wild herbaceous plants, shrubs, and wetland plants on this complex. Seepage and low rainfall limit the use of the soil for shallow water areas. Providing water, in the form of artificial catchments, is an important management practice. Wildlife species commonly present on these soils include desert iguana, zebra-tailed lizard, sidewinder, desert kangaroo rat, and horned lark and other nongame birds.

The Rositas soil is moderately limited for urban development because of the slope and severely limited for recreational development because of the sandy texture. The Ligurta soil is moderately limited for urban development because of moderate shrink-swell potential and

severely limited for recreational development because of the small stones. The Ligurta soil is severely limited for septic tank absorption fields because of moderately slow permeability, and the Rositas soil is moderately limited because of slope. Because these soils are highly susceptible to soil blowing, windbreaks and other kinds of plant cover should be provided before construction is begun.

This complex is in capability unit IVs-7, irrigated, and capability subclass VIIs, nonirrigated.

27—Salorthids, nearly level. These deep, poorly drained, strongly saline soils are on flood plains of the Gila and Colorado Rivers. The soils formed in alluvial deposits. Elevation ranges from 100 to 600 feet. The average annual precipitation ranges from 2 to 4 inches, the average annual air temperature ranges from 72 to 76 degrees F, and the average freeze-free period ranges from 250 to 325 days.

Typically, the surface layer is stratified light brown, light yellowish brown, and brown silty loam, silty clay loam, and clay about 7 inches thick. Below this to a depth of 60 inches or more is highly stratified pink, light brown, and pale brown silt loam, silty clay loam, and clay. Distinct yellow mottles line old root channels throughout the profile.

Included with these soils in mapping are small areas of Indio silt loam, strongly saline; Gadsden clay; Lagunita loamy sand; and Vint loamy fine sand.

Permeability of Salorthids, nearly level, is moderate to slow. Potential rooting depth is restricted to the upper boundary of the water table. The amount of water available for plant growth is low because of the high content of salt. Surface runoff is medium, and the hazard of water erosion is slight. These soils are saturated with very salty ground water at a shallow to moderate depth. The capillary rise of the saline water and its evaporation concentrate the salts in the upper part of the profile, which leaves a white crust on the surface. These soils are subject to rare flooding.

These soils are used for livestock grazing and for wildlife habitat.

The potential plant community on these soils is mainly iodinebush, arrowweed, big saltbush, and saltcedar.

Palatable forage plants are more abundant on the edges of areas of these soils than on most of the other soils in the survey area, but use by livestock is moderately limited by the hazard of flooding, a high water table, and high content of toxic salts.

These soils have good potential for openland and wetland wildlife habitat. Typical reptiles on these soils are desert spiny lizard, tree lizard, Yuma kingsnake, and western diamondback rattlesnake. Typical mammals are deer mouse and cottontail rabbit. Typical birds are Cooper's hawk, white-winged dove, mourning dove, and ladder-backed woodpecker.

These soils are severely limited for urban development and septic tank absorption fields because of the high water table and the hazard of flooding.

These soils are in capability subclass VIIw, nonirrigated.

28—Superstition sand. This deep, somewhat excessively drained soil is on the old terrace of the Colorado River. It formed in mixed sandy alluvium. Elevation ranges from 100 to 600 feet. The average annual precipitation ranges from 2 to 4 inches, the average annual air temperature ranges from 72 to 76 degrees F, and the average freeze-free period ranges from 250 to 325 days.

Typically, the surface layer is light brown sand about 5 inches thick. The underlying material to a depth of 60 inches or more is light brown and pink sand and contains few to many soft lime masses. In some places the surface layer is loamy sand.

Included with this soil in mapping are small areas of Rositas sand.

Permeability of this Superstition soil is rapid. Potential rooting depth is 60 inches or more. Available water capacity is low to moderate. Surface runoff is very slow. The hazard of soil blowing is high.

This soil is used mainly for rangeland, but many areas are used for irrigated citrus fruit, alfalfa hay, small grain, cotton, and vegetables.

The potential plant community is mainly creosotebush and sandverbena.

This soil is poorly suited to livestock grazing because of low production of forage and lack of livestock watering facilities. The main objective of grazing management should be to maintain the native plant cover for control of soil blowing.

Nonirrigated areas of this soil have poor potential for rangeland wildlife habitat. Irrigated areas have very poor potential for openland wildlife habitat and very poor potential for wetland wildlife habitat. Development of water, in the form of artificial catchments, is an important habitat management practice on this soil. Typical reptiles on this soil are desert iguana, sidewinder, and zebra-tailed lizard. Typical mammals are kangaroo rat, pocket mouse, and black-tailed jackrabbit.

This soil is slightly limited for urban development and severely limited for recreational development because of the sandy texture. It is slightly limited for septic tank absorption fields but is severely limited for sewage lagoons because of rapid permeability. In populated areas, community sewage systems may be needed to prevent contamination of the ground water supply as a result of seepage.

This soil is in capability unit IIIs-7, irrigated, and capability subclass VIIs, nonirrigated.

29—Superstition complex. These deep, nearly level, somewhat excessively drained soils are on old terraces of the Colorado River. They formed in mixed, sandy

alluvium. Elevation ranges from 100 to 600 feet. The average annual precipitation ranges from 2 to 4 inches, the average annual air temperature ranges from 72 to 76 degrees F, and the average freeze-free period ranges from 250 to 325 days.

Included with these soils in mapping are small areas of Superstition sand and Rositas sand.

Because of siltation during past irrigation with Colorado River water, the surface layer is light brown clay, light brown sandy clay loam, or light brown loam 5 to 10 inches thick. All three surface layer textures occur at random throughout each mapped area. The underlying material to a depth of 60 inches or more is light brown sand. It contains few to many soft lime masses.

Permeability of these Superstition soils is rapid. Potential rooting depth is 60 inches or more. Available water capacity is low. Surface runoff is slow, and the hazard of water erosion is slight.

These soils are used for irrigated citrus fruit, alfalfa hay, and small grain.

If these soils are irrigated, they are suited to all adapted crops. All crops respond to nitrogen fertilizer, especially if a legume is not included in the cropping system. Phosphorus may be needed if alfalfa and other legumes are grown. Organic matter content, soil tilth, water intake rate, and other factors of soil condition can be maintained or improved by returning crop residue and adding manure to the soil.

Irrigation water can be applied efficiently by using sprinkler, low pressure emitter, border, or furrow irrigation systems. Sprinkler systems are less efficient if all systems are operated at maximum potential. Furrow and border systems require land preparation. Among the suitable land preparation practices are leveling the soil and determining the proper length of runs. Water can be distributed by lined ditches or pipelines. Special design of sprinklers and emitters is needed. The moisture content of the soil should be determined before applying irrigated water, and then the correct amount of water should be applied at the right time. The amount of irrigation water applied should be measured to obtain high irrigation efficiency. Light, frequent applications of water are essential. Tailwater should be eliminated, or water recovery systems or pumpback systems, or both, should be used.

Irrigated areas have poor potential for openland wildlife habitat and very poor potential for wetland wildlife habitat. Leaving brushy areas and trees along the field borders and managing wet areas are important practices in irrigated areas. Typical reptiles on these soils are desert iguana, sidewinder, and zebra-tailed lizard. Typical mammals are kangaroo rat, pocket mouse, and black-tailed jackrabbit.

These soils are slightly limited for urban development and moderately limited for recreational development because they are too clayey on the surface. They are slightly limited for septic tank absorption fields but are severely limited for sewage lagoons because of rapid permeability. In populated areas, central sewage systems may be needed to prevent contamination of the ground water supply as a result of seepage.

These soils are in capability unit IIIs-7, irrigated, and capability subclass VIIs, nonirrigated.

30—Torriorthents-Torrifluvents complex, 1 to 50 percent slopes. These deep, well drained, nearly level to steep soils are on terrace escarpments and alluvial fans that have been dissected by geologic erosion. The soils formed in mixed, unconsolidated alluvial sediment. Elevation ranges from 400 to 1,200 feet. The average annual precipitation ranges from 2 to 4 inches, the average annual air temperature ranges from 72 to 76 degrees F, and the average freeze-free period ranges from 250 to 325 days.

Torriorthents make up about 50 percent of this complex. These soils are on the higher parts of the alluvial fans (fig. 12). They have slopes of 1 to 50 percent. Torrifluvents make up about 30 percent of this complex. These soils are on the lower parts of the alluvial fans. They have slopes of 1 to 15 percent. Lagunita loamy sand, Carrizo very gravelly sand, and Rositas sand make up the remaining 20 percent of the complex.

Torriorthents are highly variable in texture. They range from sand to clay and are 10 to 50 percent coarse fragments.

Permeability of the Torriorthents is variable. Potential rooting depth is 60 inches or more. Available water capacity is low. Surface runoff is rapid, and the hazard of water erosion is slight.

Torrifluvents are highly variable in texture. They range from sand to clay and are highly stratified.

Permeability of the Torrifluvents is moderate to moderately slow. Potential rooting depth is 60 inches or more. Available water capacity is moderate to high. Surface runoff is medium to rapid, and the hazard of water erosion is slight.

These soils are used for limited livestock grazing and for wildlife habitat. In some areas these soils are a good source of sand and gravel.

The native vegetation on this complex is mainly big galleta, littleleaf paloverde, creosotebush, white bursage and desert saltbush.

The use of these soils for grazing by livestock is limited because of variability of forage production from year to year and because of the lack of adequate livestock watering facilities. Palatable forage plants are more abundant on the Torrifluvents than on the Torriorthents. Grazing should be managed to minimize the disturbance of the plant cover, which would increase the susceptibility of these soils to erosion.

The potential for rangeland wildlife on this complex is poor because of low rainfall. Water development is one of the most important practices needed when managing this complex for wildlife habitat. Typical species of wild-

life on the complex are coyote, shrike, cottontail rabbit, and diamondback rattlesnake.

This complex is severely limited for farming, for urban and recreational development, and for septic tank absorption fields because of slope, content of small stones and variability in soil texture.

This complex is in capability subclass VIIe, nonirrigated.

31—Tremant-Rositas complex. These deep, well drained and somewhat excessively drained, level to gently sloping soils are on low terraces, old alluvial fans, and sand dunes. The soils formed in mixed gravelly alluvium and mixed, sandy, windblown material. Elevation ranges from 400 to 800 feet. The average annual precipitation ranges from 2 to 4 inches, the average annual air temperature ranges from 72 to 76 degrees F, and the average freeze-free period ranges from 250 to 325 days.

The Tremant soil makes up about 50 percent of this complex, and the Rositas soil makes up about 30 percent. The Tremant soil is in the more nearly flat areas. The Rositas soil is on windblown sand dunes. Antho sandy loam, Dateland fine sandy loam, and Carrizo very gravelly sand make up the remaining 20 percent of the complex.

Typically, the Tremant soil has a surface layer of light yellowish brown gravelly loam about 2 inches thick. The subsoil to a depth of 60 inches or more is light yellowish brown, reddish yellow, and light brown gravelly loam, gravelly sandy clay loam, and clay loam.

Permeability of the Tremant soil is moderately slow. Potential rooting depth is 60 inches or more. Available water capacity is high. Surface runoff is medium, and the hazard of water erosion is slight.

Typically, the Rositas soil is light brown sand to a depth of 60 inches or more.

Permeability of the Rositas soil is rapid. Potential rooting depth is 60 inches or more. Available water capacity is low. Surface runoff is very slow, and the hazard of water erosion is slight. The hazard of soil blowing is high.

This complex is used mainly as rangeland, but small areas are used for irrigated alfalfa hay, cotton, small grain, citrus fruit, safflower, grapes, and grain sorghum.

If this soil is irrigated, it is suited to all adapted crops. All crops respond to nitrogen fertilizer, especially if a legume is not included in the cropping system. Phosphorus may be needed if alfalfa and other legumes are grown. Organic matter content, soil tilth, water intake rate, and other factors of soil condition can be maintained or improved by returning crop residue and adding manure to the soil. The risk of soil blowing can be reduced by growing a cover crop.

Irrigation water can be applied efficiently by using sprinkler, low pressure emitter, or furrow irrigation systems. Furrow systems are less efficient if all systems are operated at maximum potential. Furrow systems require land preparation. Among the suitable land preparation practices are leveling the soil and determining the proper length of runs. Water can be distributed by lined ditches or pipelines. Special design of sprinklers and emitters is needed. The moisture content of the soil should be determined before applying irrigation water, and then the correct amount of water should be applied at the right time. The amount of irrigation water applied should be measured to obtain high irrigation efficiency. Light, frequent applications of water are essential. Tailwater should be eliminated.

The potential plant community on the Tremant soil is mainly creosotebush, white bursage, and triangle bursage; on the Rositas soil it is mainly big galleta, primrose, and white bursage.

Livestock grazing on this complex is limited by the unpalatability of the forage plants, the variability of forage production, and the lack of livestock watering facilities. Grazing management that helps to maintain the native vegetation is important, particularly on the Rositas soil. Windbreaks and other kinds of cover are needed to control soil blowing.

Nonirrigated areas of this complex have poor or very poor potential for rangeland wildlife habitat. Irrigated areas have very poor potential for openland wildlife habitat and poor or very poor potential for wetland wildlife habitat. Water development is one of the more important management practices needed on this complex. Leaving brushy areas and large trees along field borders is also an important management practice. Typical reptiles on this complex are collared lizard, desert spiny lizard, and desert side-blotched lizard. Typical mammals are black-tailed jackrabbit, kangaroo rat, pocket mouse, and pocket gopher. Typical birds are mourning dove, loggerhead shrike, orange-crowned warbler, and brown towhee.

The Tremant soil is moderately limited for urban development because of low strength and the shrink-swell potential, moderately limited for recreational development because of small stones in the profile, and moderately limited for septic tank absorption fields because of moderately slow permeability. In populated areas, central sewage systems may be needed to prevent contamination of the ground water supply as a result of seepage. The Rositas soil is severely limited for recreational development because of slope and sandy texture. It is slightly limited for urban development and septic tank absorption fields.

This complex is in capability subclass VIIs, nonirrigated.

32—Vint loamy fine sand. This deep, nearly level, well drained soil is on flood plains and low terraces. It formed in mixed sandy alluvium. Elevation ranges from 75 to 600 feet. The average annual precipitation ranges from 2 to 4 inches, the average annual air temperature ranges from 72 to 76 degrees F, and the average freeze-free period ranges from 250 to 325 days.

Typically, the surface layer is pale brown loamy fine sand about 16 inches thick. The underlying material is light brownish gray loamy fine sand to a depth of 32 inches. Below this it is stratified, light yellowish brown silt loam, pale brown loamy fine sand, and pale brown silty clay loam that extends to a depth of 60 inches or more.

Included with this soil in mapping are small areas of Lagunita loamy sand, Indio silt loam, and Gilman loam.

Permeability of this Vint soil is moderately rapid. Potential rooting depth is 60 inches or more. Available water capacity is moderate. Surface runoff is very slow, and the hazard of water erosion is slight. The hazard of soil blowing is high. This soil is normally subject to rare flooding, but it is now protected by dams or levees, or both, on the Colorado and Gila Rivers.

This soil is used mainly for irrigated cotton, citrus fruit, alfalfa hay, small grain, vegetables, and grain sorghum. Small areas are used for limited livestock grazing.

If this soil is irrigated, it is suited to all adapted crops. All crops respond to nitrogen fertilizer, especially if a legume is not included in the cropping system. Phosphorus may be needed if alfalfa and other legumes are grown. Organic matter content, soil tilth, water intake rate, and other factors of soil condition can be maintained or improved by returning crop residue and by adding manure to the soil. The risk of soil blowing can be reduced by growing a cover crop.

Irrigation water can be applied efficiently by using sprinkler, low pressure emitter, or furrow irrigation systems. Furrow systems are less efficient if all systems are operated at maximum potential. Furrow systems require land preparation. Among the suitable land preparation practices are leveling the soil and determining the proper length of runs. Water can be distributed by lined ditches or pipelines. Special design of sprinklers and emitters is needed. The moisture content of the soil should be determined before applying irrigation water, and then the correct amount of water should be applied at the right time. The amount of irrigation water applied should be measured to obtain high irrigation efficiency. Light, frequent applications of water are essential. Tailwater should be eliminated.

The native vegetation on this soil is mainly big galleta, annual grasses, and annual forbs. The hazard of soil blowing is high if the native plant cover is not preserved. Windbreaks and other kinds of cover help to control soil blowing.

Irrigated areas of this soil have good potential for openland wildlife habitat and very poor potential for wetland wildlife habitat. Leaving native brushy areas and large trees along field borders is an important management practice. Typical mammals on this soil are valley pocket gopher, deer mouse, black-tailed jackrabbit, round-tailed ground squirrel, and Yuma antelope squirrel. Typical birds are meadowlark, marsh hawk, and mourning dove. Typical reptiles are collared lizard, desert spiny lizard, and desert side-blotched lizard.

This soil is moderately limited for recreational development because of flooding and blowing dust and sand. It is slightly limited for septic tank absorption fields. In populated areas, central sewage systems may be needed to prevent contamination of the ground water supply.

This soil is in capability unit IIs-7, irrigated, and capability subclass VIIs, nonirrigated.

33—Wellton loamy sand. This deep, well drained, nearly level to gently sloping soil is on broad alluvial fans and terraces. It formed in mixed alluvium. Elevation ranges from 200 to 1,200 feet. The average annual precipitation ranges from 2 to 4 inches, the average annual air temperature ranges from 72 to 76 degrees F, and the average freeze-free period ranges from 250 to 325 days.

Typically, the surface layer is light brown loamy sand about 8 inches thick. The subsoil to a depth of 51 inches is light brown and reddish yellow fine gravelly sandy loam over light brown fine gravelly coarse sandy loam or loamy sand that extends to a depth of 60 inches or more.

Included with this soil in mapping are small areas of Dateland loamy fine sand and Antho sandy loam.

Permeability of this Wellton soil is moderately rapid. Potential rooting depth is 60 inches or more. Available water capacity is moderate. Surface runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is high.

This soil is used mainly for irrigated cotton, citrus fruit, alfalfa hay, vegetables, small grain, and grain sorghum. Some areas are used as rangeland.

If this soil is irrigated, it is suited to all adapted crops. All crops respond to nitrogen fertilizer, especially if a legume is not included in the cropping system. Phosphorus may be needed if alfalfa and other legumes are grown. Organic matter content, soil tilth, water intake rate, and other factors of soil condition can be maintained or improved by returning crop residue and adding manure to the soil. The risk of soil blowing can be reduced by growing a cover crop.

Irrigation water can be applied efficiently by using sprinkler, low pressure emitter, border, or furrow irrigation systems. Border and furrow systems are less efficient if all systems are operated at maximum potential. Border and furrow systems require land preparation. Among the suitable land preparation practices are leveling the soil and determining the proper length of runs and the proper width of borders. Water can be distributed by earth ditches, lined ditches, or pipelines. The moisture content of the soil should be determined before applying irrigation water, and then the correct amount of water should be applied at the right time. The amount of irrigation water applied should be measured to obtain high irrigation efficiency. Tailwater should be eliminated, or water recovery systems or pumpback systems, or both, should be used.

The potential plant community is mainly white bursage, creosotebush, big galleta, and pricklypear.

Livestock grazing on this soil is limited because of the great variability in forage production. If excessively disturbed, this soil is very susceptible to soil blowing. Grazing management that helps to maintain the native plant cover is very important.

This soil has good potential for openland and rangeland wildlife habitat and poor potential for rangeland and wetland wildlife habitat. Development of watering facilities, in the form of artificial catchments, is an important management practice. Typical mammals on this soil are kangaroo rat, pocket mouse, and black-tailed jackrabbit. Typical reptiles are desert iguana, sidewinder, and zebra-tailed lizard.

This soil is slightly limited for urban development and for septic tank absorption fields and is moderately limited for recreational development because of the sandy texture. It is suited to those lawn grasses, shrubs, and trees that are not sensitive to lime, which induces chlorosis. An annual application of iron chelate reduces this problem.

This soil is in capability unit IIs-7, irrigated, and capability subclass VIIs, nonirrigated.

34—Wellton-Dateland-Rositas complex. These deep, gently sloping to moderately sloping soils are on old alluvial fans and sand dunes. They formed in mixed alluvium and in mixed, sandy, windblown material. Elevation ranges from 400 to 800 feet. The average annual precipitation ranges from 2 to 4 inches, the average annual air temperature ranges from 72 to 76 degrees F, and the average freeze-free period ranges from 250 to 325 days.

The Wellton soil makes up about 40 percent of this complex, the Dateland soil about 30 percent, and the Rositas soil about 20 percent. Antho fine sandy loam, Tremant gravelly loam, and Cristobal very gravelly loam make up the remaining 10 percent.

Typically, the well drained Wellton soil has a surface layer of very pale brown loamy sand about 8 inches thick. The subsoil to a depth of 60 inches or more is very pale brown and reddish yellow loamy sand, sandy loam, and gravelly sandy loam.

Permeability of the Wellton soil is moderately rapid. Potential rooting depth is 60 inches or more. Available water capacity is moderate. Surface runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is high.

Typically, the well drained Dateland soil has a surface layer of brown loamy fine sand about 6 inches thick. The subsoil is light yellowish brown sandy loam about 21 inches thick. The substratum to a depth of 60 inches or more is pale brown loam and fine sandy loam.

Permeability of the Dateland soil is moderately rapid. Potential rooting depth is 60 inches or more. Available water capacity is moderate. Surface runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is high.

Typically, the somewhat excessively drained Rositas soil is light brown sand to a depth of 60 inches or more.

Permeability of the Rositas soil is rapid. Potential rooting depth is 60 inches or more. Available water capacity is low. Surface runoff is very slow, and the hazard of water erosion is slight. The hazard of soil blowing is high.

These soils are mainly used as rangeland, but small areas are used for irrigated cotton, citrus fruit, alfalfa hay, vegetables, small grain, and grain sorghum.

If these soils are irrigated, they are suited to all adapted crops. All crops respond to nitrogen fertilizer, especially if a legume is not included in the cropping system. Phosphorus may be needed if alfalfa and other legumes are grown. Organic matter content, soil tilth, water intake rate, and other factors of soil condition can be maintained or improved by returning crop residue and adding manure to the soil. The risk of soil blowing can be reduced by growing a cover crop.

Irrigation water can be applied efficiently by using sprinkler, low pressure emitter, border, or furrow irrigation systems. Border and furrow systems are less efficient if all systems are operated at maximum potential. Border and furrow systems require land preparation. Among the suitable land preparation practices are leveling the soil and determining the proper length of runs and the proper width of borders. Water can be distributed by earth ditches, lined ditches, or pipelines. The moisture content of the soil should be determined before applying irrigation water, and then the correct amount of water should be applied at the right time. The amount of irrigation water applied should be measured to obtain high irrigation efficiency. Tailwater should be eliminated, or water recovery systems or pumpback systems, or both, should be used.

The potential plant community on the Wellton soil is mainly white bursage, creosotebush, and big galleta; on the Dateland soil it is mainly creosotebush, white bursage, and ratany; and on the Rositas soil it is mainly white bursage, big galleta, and primrose.

Palatable forage plants are much more abundant on the Rositas soil than on the Wellton and Dateland soils. Livestock grazing is limited on all three soils, however, because of the variability in forage production from year to year and because of the lack of adequate livestock watering facilities. The Rositas soil is particularly susceptible to soil blowing, but grazing management should be designed for all three soils to minimize the disturbance of the native plant cover. Windbreaks and other kinds of cover help to control soil blowing.

The potential of this complex is very poor for wetland wildlife habitat and poor for rangeland wildlife habitat. A suitable management practice for wildlife habitat on this complex is the development of watering facilities, such as artificial catchments. Typical wildlife species on the complex are zebra-tailed lizard, western diamondback

rattlesnake, desert kangaroo rat, round-tailed squirrel, Yuma antelope squirrel, and black-tailed jackrabbit.

The soils in this complex are slightly limited for urban development and moderately limited for recreational development because of sandy texture and slope. They are slightly limited for septic tank absorption fields.

This complex is in capability unit IVs-7, irrigated, and capability subclass VIIs, nonirrigated.

Use and management of the soils

The soil survey is a detailed inventory and evaluation of the most basic resource of the survey area—the soil. It is useful in adjusting land use, including urbanization, to the limitations and potentials of natural resources and the environment. Also, it can help avoid soil-related failures in uses of the land.

While a soil survey is in progress, soil scientists, conservationists, engineers, and others keep extensive notes about the nature of the soils and about unique aspects of behavior of the soils. These notes include data on erosion, drought damage to specific crops, yield estimates, flooding, the functioning of septic tank disposal systems, and other factors affecting the productivity, potential, and limitations of the soils under various uses and management. In this way, field experience and measured data on soil properties and performance are used as a basis for predicting soil behavior.

Information in this section is useful in planning use and management of soils for crops and pasture, rangeland, and as sites for buildings, highways and other transportation systems, sanitary facilities, and parks and other recreation facilities, and for wildlife habitat. From the data presented, the potential of each soil for specified land uses can be determined, soil limitations to these land uses can be identified, and costly failures in houses and other structures, caused by unfavorable soil properties, can be avoided. A site where soil properties are favorable can be selected, or practices that will overcome the soil limitations can be planned.

Planners and others using the soil survey can evaluate the impact of specific land uses on the overall productivity of the survey area or other broad planning area and on the environment. Productivity and the environment are closely related to the nature of the soil. Plans should maintain or create a land-use pattern in harmony with the natural soil.

Contractors can find information that is useful in locating sources of sand and gravel, roadfill, and topsoil. Other information indicates the presence of bedrock, wetness, or very firm soil horizons that cause difficulty in excavation.

Health officials, highway officials, engineers, and many other specialists also can find useful information in this soil survey. The safe disposal of wastes, for example, is closely related to properties of the soil. Pavements, sidewalks, campsites, playgrounds, lawns, and trees and shrubs are influenced by the nature of the soil.

Crops

The major management concern in the use of the soils for crops is described in this section. In addition, the estimated yields of the main crops and hay are presented for each soil, and the system of land capability classification used by the Soil Conservation Service is explained.

This section provides information about the overall agricultural potential of the survey area and about the management practices that are needed. The information is useful to equipment dealers, land improvement contractors, fertilizer companies, processing companies, planners, conservationists, and others. For each kind of soil, information about management is presented in the section "Soil maps for detailed planning." Planners of management systems for individual fields or farms should also consider the detailed information given in the description of each soil.

Salinity

The problem of salinity in the survey area is a direct result of the long period during which the soils in the area have been irrigated and the quality of the irrigation water that has been used. Until large quantities of irrigation water from the Colorado River became available, most of the water came from wells that provided saline water. When this water was used, the crops on the soils removed the moisture and the salt remained in the soils. Gradually the salinity of the soils increased.

As more water of better quality became available from the Colorado River, less water was pumped from wells. Irrigation with large quantities of water from the Colorado River eventually caused the water table to rise. The ground water, already saline, increased in salinity as more salts were contributed from the Colorado River water. As a result of evapotranspiration and capillary movement, these salts were returned to the upper layers of the soils, where they affect crop growth.

During recent years, farmers and other concerned groups have increased their efforts to lower the water table in the survey area by pumping out the ground water. As a result, the water table has been lowered markedly and the salinity of the soils has been reduced (fig. 13). The goal of the salinity control program in the Wellton-Mohawk area is to reduce the return flow of water by 35 to 40 percent, or 78,000 acre-feet per year, by 1981. Reducing the return flow by that much not only will conserve more than 25 billion gallons of water each year, it also will cut the Colorado River's annual salt load by 500,000 tons.

In the following paragraphs the nature and properties of the saline soils in the survey area are discussed in more detail.

The existence of a salinity problem is directly related to the transport and deposition of salt by water. The major processes involved are infiltration, drainage, evaporation, and transpiration. In irrigated farming, important considerations are the degree of salinity prior to irrigation; the increase in salinity as a result of irrigation; and the management practices that can be used to improve saline soils or to satisfactorily control the salinity environment of crop plants, or both.

Whether the salinity of a soil is high enough to affect plant growth depends upon such factors as the texture of the soil, the distribution of salts in the profile, the composition of the salts, and the species of plants grown. A soil is considered to be saline if the solution extracted from a saturated soil paste has an electrical conductivity value of 4 millimhos per centimeter or more. Among the saline soils in the survey area are those in the Wellton-Hyder, Dateland, and Aztec areas.

Saline soils are commonly recognized by the presence of a white crust on the surface. An example of such soils is Indio silt loam, strongly saline. In addition, crops grown on saline soils generally have barren spots and may be stunted, may vary considerably in size, or may have dark bluish green foliage. In this survey area plants grown on the Harqua soils exhibit these characteristics.

Excess salinity delays or prevents germination and reduces the rate of plant growth. These effects are mainly associated with the high osmotic pressure of the soil solution, which reduces the ability of plants to absorb water. Some of these effects, however, may result from nutritional imbalance or from toxicity caused by specific ions (*11*).

The soils in the survey area have been affected mainly by an excessive concentration of salts of calcium and magnesium and by chlorides and sulfates. One original source of these salts in this area is the exposed volcanic rock and minerals in the earth's crust. The soluble salts have been gradually released as a result of chemical decomposition and physical weathering. In this arid region, leaching is local and the salts are not transported far because of the scarcity of rainfall. Also, the high evaporation and transpiration rates typical of this climate tend to reduce the amount of water available for leaching and transporting these soluble salts. Except for the irrigation water that comes from the Colorado River (fig. 14), the major source of the salts that contribute to the salinity problem is the Cristobal, Harqua, and Ligurta soils.

A salinity problem has also developed in areas of soils that have adequate natural drainage but that are not adequately drained when irrigated. In these soils, a large quantity of water has percolated into the lower layers and the water table has been raised from a considerable depth to within a few feet of the surface.

Yields per acre

The average yields per acre that can be expected of the principal crops under a high level of management are shown in table 6. In any given year, yields may be higher or lower than those indicated in the table because of variations in rainfall and other climatic factors. Absence of an estimated yield indicates that the crop is not suited to or is not commonly grown on the soil or that a given crop is not commonly irrigated.

The estimated yields were based mainly on the experience and records of farmers, conservationists, and extension agents. Results of field trials and demonstrations and available yield data from nearby counties were also considered.

The yields were estimated assuming that the latest soil and crop management practices were used. Hay yields were estimated for the most productive varieties suited to the climate and the soil. A few farmers may be obtaining average yields higher than those shown in table 6.

The management needed to achieve the indicated yields of the various crops depends on the kind of soil and the crop. Such management provides drainage, erosion control, and protection from flooding; the proper planting and seeding rates; suitable high-yielding crop varieties; appropriate tillage practices, including time of tillage and seedbed preparation and tilling when soil moisture is favorable; control of weeds, plant diseases, and harmful insects; favorable soil reaction and optimum levels of nitrogen, phosphorus, potassium, and trace elements for each crop; effective use of crop residue, barnyard manure, and green-manure crops; harvesting crops with the smallest possible loss; and timeliness of all fieldwork.

For yields of irrigated crops, it is assumed that the irrigation system is adapted to the soils and to the crops grown; that good quality irrigation water is uniformly applied in proper amounts as needed; and that tillage is kept to a minimum.

The estimated yields reflect the productive capacity of the soils for each of the principal crops. Yields are likely to increase as new production technology is developed. The productivity of a given soil compared with that of other soils, however, is not likely to change.

Crops other than those shown in table 6 are grown in the survey area, but estimated yields are not included because the acreage of these crops is small. The local offices of the Soil Conservation Service and the Cooperative Extension Service can provide information about the management concerns and productivity of the soils for these crops.

Capability classes and subclasses

Capability classes and subclasses show, in a general way, the suitability of soils for most kinds of field crops. The soils are classed according to their limitations when they are used for field crops, the risk of damage when

they are used, and the way they respond to treatment. The grouping does not take into account major and generally expensive landforming that would change slope, depth, or other characteristics of the soils; does not take into consideration possible but unlikely major reclamation projects; and does not apply to rice, cranberries, horticultural crops, or other crops that require special management. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for rangeland or for engineering purposes.

In the capability system, all kinds of soil are grouped at three levels: capability class, subclass, and unit. These levels are defined in the following paragraphs. A survey area may not have soils of all classes.

Capability classes, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use. The classes are defined as follows:

Class I soils have few limitations that restrict their use.

Class II soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.

Class III soils have severe limitations that reduce the choice of plants or that require special conservation practices, or both.

Class IV soils have very severe limitations that reduce the choice of plants or that require very careful management, or both.

Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use (none in the survey area).

Class VI soils have severe limitations that make them generally unsuitable for cultivation (none in the survey area).

Class VII soils have very severe limitations that make them unsuitable for cultivation.

Class VIII soils and landforms have limitations that nearly preclude their use for commercial crop production.

Capability subclasses are soil groups within one class; they are designated by adding a small letter, *e, w, s,* or *c,* to the class numeral, for example, IIe. The letter *e* shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in only some parts of the United States, shows that the chief limitation is climate that is too cold or too dry.

In class I there are no subclasses because the soils of this class have few limitations. Class V contains only the subclasses indicated by *w, s,* or *c* because the soils in class V are subject to little or no erosion, though they have other limitations that restrict their use to pasture, rangeland, wildlife habitat, or recreation. The capability subclass is listed for each nonirrigated soil in the map unit description in the section "Soil maps for detailed planning."

The capability unit is identified in the description of each irrigated soil in the soil map unit in the section "Soil maps for detailed planning." Capability units are soil groups within the subclasses. The soils in one capability unit are enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity. Thus, the capability unit is a convenient grouping for making many statements about management of soils. Capability units are generally designated by adding an Arabic numeral to the subclass symbol, for example, I-1 or IIIs-7.

Rangeland

Barry K. Wallace, range conservationist, Soil Conservation Service, helped to write this section.

About 75 percent of the survey is rangeland, but livestock grazing is usually limited to riparian vegetation along rivers and wash bottoms. When rainfall is unusually high in winter and spring, however, there is limited grazing on the desert, generally for 30 to 60 days. Permanent livestock watering facilities are almost nonexistent on the desert rangeland.

Income from raising livestock ranks second to irrigated farming in the survey area. Most of this income is derived from feedlot operations and from the raising of sheep that are grazed on alfalfa stubble.

The soils along rivers and washes in the survey area generally support riparian vegetation. The soils on uplands support shrubs, trees, and various cacti. Deep, sandy hummocks and dunes commonly support grasses.

Where climate and topography are about the same, differences in the kind and amount of vegetation that rangeland can produce are related closely to the kind of soil. Effective management is based on the relationships among soils, vegetation, and water.

Table 7 shows, for each kind of soil, the name of the range site; the total annual production of vegetation in favorable, normal, and unfavorable years; the characteristic vegetation; and the expected percentage of each species in the composition of the potential natural plant community.

A *range site* is a distinctive kind of rangeland that differs from other kinds of rangeland in its ability to produce a characteristic natural plant community. Soils that produce a similar kind, amount, and proportion of range plants are grouped into range sites. For those areas where the relationship between soils and vegetation has been established, range sites can be interpreted directly from the soil map. Properties that determine the capacity of the soil to supply moisture and plant nutrients have the greatest influence on the productivity of range

plants. Soil reaction, salt content, and a seasonal high water table are also important.

Total production refers to the amount of vegetation that can be expected to grow annually on well managed rangeland that is supporting the potential natural plant community. It is expressed in pounds per acre of air-dry vegetation for favorable, normal, and unfavorable years. In a favorable year the amount and distribution of precipitation and the temperatures are such that growing conditions are substantially better than average; in a normal year these conditions are about average for the area; in an unfavorable year, growing conditions are well below average, generally because of low available soil moisture.

Dry weight refers to the total air-dry vegetation produced per acre each year by the potential natural plant community. Vegetation that is highly palatable to livestock and vegetation that is unpalatable are included. Some of the vegetation can also be grazed extensively by wildlife.

Characteristic species of grasses, grasslike plants, forbs, and shrubs that make up most of the potential natural plant community on each soil are listed by common name. Under *Composition*, the expected proportion of each species is presented as the percentage, in air-dry weight, of the total annual production of herbaceous and woody plants. The amount that can be used as forage depends on the kinds of grazing animals and on the grazing season. Generally, all of the vegetation produced is not used.

Range management requires, in addition to knowledge of the kinds of soil and the potential natural plant community, an evaluation of the present condition of the range vegetation in relation to its potential. Range condition is determined by comparing the present plant community with the potential natural plant community on a particular range site. The more closely the existing community resembles the potential community, the better the range condition. The objective in range management is to control grazing so that the plants growing on a site are about the same in kind and amount as the potential natural plant community for that site. Such management generally results in the maximum production of vegetation, conservation of water, and control of erosion. Sometimes, however, a range condition somewhat below the potential meets grazing needs, provides wildlife habitat, and protects soil and water resources.

The major management concern on most rangeland is control of grazing so that the kinds and amounts of plants that make up the potential natural plant community are reestablished. Soil blowing occurs on sandy soils that are not adequately covered. River and wash bottoms and flood plains are severely disturbed by runoff and concentrated flood water when they are not adequately protected by vegetation or by dams and levees. Minimizing soil movement is an important management concern. Sound range management based on soil survey information and other rangeland inventory information is the basis for maintaining or improving forage production.

Recreation

Leon F. Fager, Jr., area biologist, Soil Conservation Service, helped to write this section.

The soils of the survey area are rated in table 8 according to limitations that affect their suitability for recreation uses. The ratings are based on such restrictive soil features as flooding, wetness, slope, and texture of the surface layer. Not considered in these ratings, but important in evaluating a site, are location and accessibility of the area, size and shape of the area and its scenic quality, the ability of the soil to support vegetation, access to water, potential water impoundment sites available, and either access to public sewerlines or capacity of the soil to absorb septic tank effluent. Soils subject to flooding are limited, in varying degrees, for recreation use by the duration and intensity of flooding and the season when flooding occurs. Onsite assessment of height, duration, intensity, and frequency of flooding is essential in planning recreation facilities.

The degree of the limitation of the soils is expressed as slight, moderate, or severe. *Slight* means that the soil properties are generally favorable and that the limitations are minor and easily overcome. *Moderate* means that the limitations can be overcome or alleviated by planning, design, or special maintenance. *Severe* means that soil properties are unfavorable and that limitations can be offset only by costly soil reclamation, special design, intensive maintenance, limited use, or by a combination of these measures.

The information in table 8 can be supplemented by information in other parts of this survey. Especially helpful are interpretations for septic tank absorption fields, given in table 11, and interpretations for dwellings without basements and for local roads and streets, given in table 10.

Camp areas (fig. 15) require such site preparation as shaping and leveling for tent and parking areas, stabilizing roads and intensively used areas, and installing sanitary facilities and utility lines. Camp areas are subject to heavy foot traffic and some vehicular traffic. The best soils for this use have mild slopes and are not wet or subject to flooding during the period of use. The surface has few or no stones or boulders, absorbs rainfall readily but remains firm, and is not dusty when dry. Strong slopes and stones or boulders can greatly increase the cost of constructing camping sites.

Picnic areas are subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking areas. The best soils for use as picnic areas are firm when wet, are not dusty when dry, are not subject to flooding during the period of use, and do not have slopes or stones or boulders that will increase the cost

of shaping sites or of building access roads and parking areas.

Playgrounds require soils that can withstand intensive foot traffic. The best soils are almost level and are not wet or subject to flooding during the season of use. The surface is free of stones or boulders, is firm after rains, and is not dusty when dry. If shaping is required to obtain a uniform grade, the depth of the soil over bedrock or hardpan should be enough to allow necessary grading.

Paths and trails for walking, horseback riding, bicycling, and other uses should require little or no cutting and filling. The best soils for this use are those that are not wet, are firm after rains, are not dusty when dry, and are not subject to flooding more than once during the annual period of use. They should have moderate slopes and have few or no stones or boulders on the surface.

Wildlife habitat

Leon F. Fager, Jr., area biologist, Soil Conservation Service, helped to write this section.

The wildlife habitat in the survey area can be categorized into four general types: habitat of desert mountains, habitat of desert valleys, riparian habitat, and cropland habitat. A description of the habitat in the survey area is given briefly in the following paragraphs.

Habitat of desert mountains. The variety of vegetation on desert mountains is highly dependent upon the geologic age of the range. The younger ranges have less developed soils and therefore support only sparse stands of vegetation. However, the rocky slopes are nearly inaccessible to domestic herbivores and provide more protection for vegetation. Furthermore, the many crevices and cavities in the rock formations provide wildlife protection from the extreme temperatures encountered in this desert environment. Sheer cliffs and vertical rock faces are used by many species of bird, including birds of prey, for nesting.

Habitat of desert valleys. Desert valleys are located between the mountain ranges. They vary in width from a few hundred yards to several miles. They consist of alluvial fans that spread from the mountains, sloping steeply downward at first and eventually flattening out on the valley bottom. Where two fans merge from opposite slopes, drainage channels have formed and are commonly termed washes or arroyos.

The vegetation along the washes in the desert valleys provides feeding areas and cover for wildlife. The washes are important travel routes for wildlife to and from water and feeding areas. Many species of wildlife also use the vegetation along the desert washes for nesting and shade.

Riparian habitat. The two major drainageways in the survey area are the Gila and Colorado Rivers. Water tolerant plants, commonly known as phreatophytes, are most numerous in these drainageways. Historically, these two river systems were described as virtual havens for a great variety of wildlife species. Trapping of furbearing animals such as beaver was once a thriving industry along these streams. Conditions have changed, however, because of the construction of dams and the use of irrigation. Along the Gila River, for example, little or no running water is present, and saltcedar has taken the place of cottonwood and willow as the dominant woody plants. In the survey area, riparian vegetation is most extensive along the Colorado River. Waterfowl and shorebirds use both of these systems for resting, feeding, and reproduction.

Riparian vegetation is the most productive kind of vegetation in the survey area.

Cropland habitat. Cropland provides an interesting "edge" for wildlife in the desert region. In areas where irrigated fields are adjacent to native desert, wildlife has a ready source of water and food. In other areas, where large blocks of land are devoted to intensive farming, there are fewer wildlife species because of the lack of adjacent native cover.

The major kinds of wildlife in the survey area are described in the individual map unit descriptions.

Soils directly affect the kind and amount of vegetation that is available to wildlife as food and cover, and they affect the construction of water impoundments. The kind and abundance of wildlife that populates an area depend largely on the amount and distribution of food, cover, and water. If any one of these elements is missing, is inadequate, or is inaccessible, wildlife either is scarce or does not inhabit the area.

If the soils have the potential, wildlife habitat can be created or improved by planting appropriate vegetation, by maintaining the existing plant cover, or by helping the natural establishment of desirable plants.

In table 9, the soils in the survey area are rated according to their potential to support the main kinds of wildlife habitat in the area. This information can be used in planning for parks, wildlife refuges, nature study areas, and other developments for wildlife; selecting areas that are suitable for wildlife; selecting soils that are suitable for creating, improving, or maintaining specific elements of wildlife habitat; and determining the intensity of management needed for each element of the habitat.

The potential of the soil is rated good, fair, poor, or very poor. A rating of *good* means that the element of wildlife habitat or the kind of habitat is easily created, improved, or maintained. Few or no limitations affect management, and satisfactory results can be expected if the soil is used for the designated purpose. A rating of *fair* means that the element of wildlife habitat or kind of habitat can be created, improved, or maintained in most places. Moderately intensive management is required for satisfactory results. A rating of *poor* means that limitations are severe for the designated element or kind of wildlife habitat. Habitat can be created, improved, or

maintained in most places, but management is difficult and must be intensive. A rating of *very poor* means that restrictions for the element of wildlife habitat or kind of wildlife are very severe, and that unsatisfactory results can be expected. Wildlife habitat is impractical or even impossible to create, improve, or maintain on soils having such a rating.

The elements of wildlife habitat are briefly described in the following paragraphs.

Grain and seed crops are seed-producing annuals used by wildlife. The major soil properties that affect the growth of grain and seed crops are depth of the root zone, texture of the surface layer, available water capacity, wetness, slope, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of grain and seed crops are sorghum, wheat, safflower, and barley.

Grasses and legumes are domestic perennial grasses and herbaceous legumes that are planted for wildlife food and cover. Major soil properties that affect the growth of grasses and legumes are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, flood hazard, and slope. Soil temperature and soil moisture are also considerations. Examples of grasses and legumes are fescue, lovegrass, bromegrass, clover, and alfalfa.

Wild herbaceous plants are native or naturally established grasses and forbs, including weeds, that provide food and cover for wildlife. Major soil properties that affect the growth of these plants are depth of the root zone, texture of the surface layer, available water capacity. wetness, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of wild herbaceous plants are indianwheat, bush muhly, big galleta, desert lily, spurge, buckwheat, fiddleneck, and turkshead.

Shrubs are bushy, woody plants that produce fruit, buds, twigs, bark, or foliage used by wildlife or that provide cover and shade for some species of wildlife. Major soil properties that affect the growth of shrubs are depth of the root zone, available water capacity, salinity, and moisture. Examples of shrubs are paloverde, mesquite, and fourwing saltbush.

Wetland plants are annual and perennial wild herbaceous plants that grow on moist or wet sites, exclusive of submerged or floating aquatics. They produce food or cover for wildlife that use wetland as habitat. Major soil properties affecting wetland plants are texture of the surface layer, wetness, reaction, salinity, slope, and surface stoniness. Examples of wetland plants are smartweed, wild millet, wild rice, saltgrass, cordgrass and rushes, sedges, and reeds.

Shallow water areas are bodies of water that have an average depth of less than 5 feet and that are useful to wildlife. They can be naturally wet areas, or they can be created by dams or levees or by water-control structures in marshes or streams. Major soil properties affecting shallow water areas are depth to bedrock, wetness, surface stoniness, slope, and permeability. The availability of a dependable water supply is important if water areas are to be developed. Examples of shallow water areas are marshes, waterfowl feeding areas, and ponds.

The kinds of wildlife habitat are briefly described in the following paragraphs.

Openland habitat consists of cropland, pasture, meadows, and areas that are overgrown with grasses, herbs, shrubs, and vines. These areas produce grain and seed crops, grasses and legumes, and wild herbaceous plants. The kinds of wildlife attracted to these areas include bobwhite quail, pheasant, western meadowlark, field sparrow, and cottontail rabbit.

Wetland habitat consists of open, marshy or swampy, shallow water areas where water-tolerant plants grow. Some of the wildlife attracted to such areas are ducks, geese, herons, shore birds, muskrat, and beaver.

Rangeland habitat consists of areas of wild herbaceous plants and shrubs. Wildlife attracted to rangeland include antelope, deer, desert mule deer, meadowlark, and lark bunting.

Engineering

This section provides information about the use of soils for building sites, sanitary facilities, construction material, and water management. Among those who can benefit from this information are engineers, landowners, community planners, town and city managers, land developers, builders, contractors, and farmers and ranchers.

The ratings in the engineering tables are based on test data and estimated data in the "Soil properties" section. The ratings were determined jointly by soil scientists and engineers of the Soil Conservation Service using known relationships between the soil properties and the behavior of soils in various engineering uses.

Among the soil properties and site conditions identified by a soil survey and used in determining the ratings in this section were grain-size distribution, liquid limit, plasticity index, soil reaction, depth to bedrock, hardness of bedrock that is within 5 or 6 feet of the surface, soil wetness, slope, likelihood of flooding, natural soil structure or aggregation, in-place soil density, and geologic origin of the soil material. Where pertinent, data about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kind of absorbed cations were also considered.

On the basis of information assembled about soil properties, ranges of values can be estimated for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, shear strength, compressibility, slope stability, and other factors of expected soil behavior in engineering uses. As appropriate, these values can be applied to each major horizon of each soil or to the entire profile.

These factors of soil behavior affect construction and maintenance of roads, airport runways, pipelines, foundations for small buildings, ponds and small dams, irrigation projects, drainage systems, sewage and refuse disposal systems, and other engineering works. The ranges of values can be used to (1) select potential residential, commercial, industrial, and recreational uses; (2) make preliminary estimates pertinent to construction in a particular area; (3) evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; (4) evaluate alternative sites for location of sanitary landfills, onsite sewage disposal systems, and other waste disposal facilities; (5) plan detailed onsite investigations of soils and geology; (6) find sources of gravel, sand, clay, and topsoil; (7) plan farm drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; (8) relate performance of structures already built to the properties of the kinds of soil on which they are built so that performance of similar structures on the same or a similar soil in other locations can be predicted; and (9) predict the trafficability of soils for cross-country movement of vehicles and construction equipment.

Data presented in this section are useful for land-use planning and for choosing alternative practices or general designs that will overcome unfavorable soil properties and minimize soil-related failures. Limitations to the use of these data, however, should be well understood. First, the data are generally not presented for soil material below a depth of 5 or 6 feet. Also, because of the scale of the detailed map in this soil survey, small areas of soils that differ from the dominant soil may be included in mapping. Thus, these data do not eliminate the need for onsite investigations, testing, and analysis by personnel having expertise in the specific use contemplated.

The information is presented mainly in tables. Table 10 shows, for each kind of soil, the degree and kind of limitations for building site development; table 11, for sanitary facilities; and table 13, for water management. Table 12 shows the suitability of each kind of soil as a source of construction materials.

The information in the tables, along with the soil map, the soil descriptions, and other data provided in this survey, can be used to make additional interpretations and to construct interpretive maps for specific uses of land.

Some of the terms used in this soil survey have a special meaning in soil science. Many of these terms are defined in the Glossary.

Building site development

The degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, and local roads and streets are indicated in table 10. A *slight* limitation indicates that soil properties generally are favorable for the specified use; any limitation is minor and easily overcome. A *moderate* limitation indicates that soil properties and site features are unfavorable for the specified use, but the limitations can be overcome or minimized by special planning and design. A *severe* limitation indicates that one or more soil properties or site features are so unfavorable or difficult to overcome that a major increase in construction effort, special design, or intensive maintenance is required. For some soils rated severe, such costly measures may not be feasible.

Shallow excavations are made for pipelines, sewerlines, communications and power transmission lines, basements, open ditches, and cemeteries. Such digging or trenching is influenced by soil wetness caused by a seasonal high water table; the texture and consistence of soils; the tendency of soils to cave in or slough; and the presence of very firm, dense soil layers, bedrock, or large stones. In addition, excavations are affected by slope of the soil and the probability of flooding. Ratings do not apply to soil horizons below a depth of 6 feet unless otherwise noted.

In the soil series descriptions, the consistence of each soil horizon is given, and the presence of very firm or extremely firm horizons, usually difficult to excavate, is indicated.

Dwellings and *small commercial buildings* referred to in table 10 are built on undisturbed soil and have foundation loads of a dwelling no more than three stories high. Separate ratings are made for small commercial buildings without basements and for dwellings with and without basements. For such structures, soils should be sufficiently stable that cracking or subsidence of the structure from settling or shear failure of the foundation does not occur. These ratings were determined from estimates of the shear strength, compressibility, and shrink-swell potential of the soil. Soil texture, plasticity and in-place density, soil wetness, and depth to a seasonal high water table were also considered. Soil wetness and depth to a seasonal high water table indicate potential difficulty in providing adequate drainage for basements, lawns, and gardens. Depth to bedrock, slope, and large stones in or on the soil are also important considerations in the choice of sites for these structures and were considered in determining the ratings. Susceptibility to flooding is a serious hazard.

Local roads and streets referred to in table 10 have an all-weather surface that can carry light to medium traffic all year. They consist of a subgrade of the underlying soil material; a base of gravel, crushed rock fragments, or soil material stabilized with lime or cement; and a flexible or rigid surface, commonly asphalt or concrete. The roads are graded with soil material at hand, and most cuts and fills are less than 6 feet deep.

The load supporting capacity and the stability of the soil as well as the quantity and workability of fill material available are important in design and construction of roads and streets. The classifications of the soil and the

soil texture, density and shrink-swell potential are indicators of the traffic supporting capacity used in making the ratings. Soil wetness, flooding, slope, depth to hard rock or very compact layers, and content of large stones affect stability and ease of excavation.

Sanitary facilities

Favorable soil properties and site features are needed for proper functioning of septic tank absorption fields, sewage lagoons, and sanitary landfills. The nature of the soil is important in selecting sites for these facilities and in identifying limiting soil properties and site features to be considered in design and installation. Also, those soil properties that affect ease of excavation or installation of these facilities will be of interest to contractors and local officials. Table 11 shows the degree and kind of limitations of each soil for such uses and for use of the soil as daily cover for landfills. It is important to observe local ordinances and regulations.

If the degree of soil limitation is expressed as *slight*, soils are generally favorable for the specified use and limitations are minor and easily overcome; if *moderate*, soil properties or site features are unfavorable for the specified use, but limitations can be overcome by special planning and design; and if *severe*, soil properties or site features are so unfavorable or difficult to overcome that major soil reclamation, special designs, or intensive maintenance is required. Soil suitability is rated by the terms *good*, *fair*, or *poor*, which, respectively, mean about the same as the terms *slight*, *moderate*, and *severe*.

Septic tank absorption fields are subsurface systems of tile or perforated pipe that distribute effluent from a septic tank into the natural soil. Only the soil horizons between depths of 24 and 72 inches are evaluated for this use. The soil properties and site features considered are those that affect the absorption of the effluent and those that affect the construction of the system.

Properties and features that affect absorption of the effluent are permeability, depth to seasonal high water table, depth to bedrock, and susceptibility to flooding. Stones, boulders, and shallowness to bedrock interfere with installation. Excessive slope can cause lateral seepage and surfacing of the effluent. Also, soil erosion and soil slippage are hazards if absorption fields are installed on sloping soils.

In some soils, loose sand and gravel or fractured bedrock is less than 4 feet below the tile lines. In these soils the absorption field does not adequately filter the effluent, and ground water in the area may be contaminated.

On many of the soils that have moderate or severe limitations for use as septic tank absorption fields, a system to lower the seasonal water table can be installed or the size of the absorption field can be increased so that performance is satisfactory.

Sewage lagoons are shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid wastes. Lagoons have a nearly level floor and cut slopes or embankments of compacted soil material. Aerobic lagoons generally are designed to hold sewage within a depth of 2 to 5 feet. Nearly impervious soil material for the lagoon floor and sides is required to minimize seepage and contamination of ground water. Soils that are very high in content of organic matter and those that have cobbles, stones, or boulders are not suitable. Unless the soil has very slow permeability, contamination of ground water is a hazard where the seasonal high water table is above the level of the lagoon floor. In soils where the water table is seasonally high, seepage of ground water into the lagoon can seriously reduce the lagoon's capacity for liquid waste. Slope, depth to bedrock, and susceptibility to flooding also affect the suitability of sites for sewage lagoons or the cost of construction. Shear strength and permeability of compacted soil material affect the performance of embankments.

Sanitary landfill is a method of disposing of solid waste by placing refuse in successive layers either in excavated trenches or on the surface of the soil. The waste is spread, compacted, and covered daily with a thin layer of soil material. Landfill areas are subject to heavy vehicular traffic. Risk of polluting ground water and trafficability affect the suitability of a soil for this use. The best soils have a loamy or silty texture, have moderate to slow permeability, are deep to a seasonal water table, and are not subject to flooding. Clayey soils are likely to be sticky and difficult to spread. Sandy or gravelly soils generally have rapid permeability, which might allow noxious liquids to contaminate ground water. Soil wetness can be a limitation, because operating heavy equipment on a wet soil is difficult. Seepage into the refuse increases the risk of pollution of ground water.

Ease of excavation affects the suitability of a soil for the trench type of landfill. A suitable soil is deep to bedrock and free of large stones and boulders. If the seasonal water table is high, water will seep into trenches.

Unless otherwise stated, the limitations in table 11 apply only to the soil material within a depth of about 6 feet. If the trench is deeper, a limitation of slight or moderate may not be valid. Site investigation is needed before a site is selected.

Daily cover for landfill should be soil that is easy to excavate and spread over the compacted fill in wet and dry periods. Soils that are loamy or silty and free of stones or boulders are better than other soils. Clayey soils may be sticky and difficult to spread; sandy soils may be subject to soil blowing.

The soils selected for final cover of landfills should be suitable for growing plants. Of all the horizons, the A horizon in most soils has the best workability, more organic matter, and the best potential for growing plants.

Thus, for either the area- or trench-type landfill, stockpiling material from the A horizon for use as the surface layer of the final cover is desirable.

Where it is necessary to bring in soil material for daily or final cover, thickness of suitable soil material available and depth to a seasonal high water table in soils surrounding the sites should be evaluated. Other factors to be evaluated are those that affect reclamation of the borrow areas. These factors include slope, erodibility, and potential for plant growth.

Construction materials

The suitability of each soil as a source of roadfill, sand, gravel, and topsoil is indicated in table 12 by ratings of good, fair, or poor. The texture, thickness, and organic-matter content of each soil horizon are important factors in rating soils for use as construction materials. Each soil is evaluated to the depth observed, generally about 6 feet.

Roadfill is soil material used in embankments for roads. Soils are evaluated as a source of roadfill for low embankments, which generally are less than 6 feet high and less exacting in design than high embankments. The ratings reflect the ease of excavating and working the material and the expected performance of the material where it has been compacted and adequately drained. The performance of soil after it is stabilized with lime or cement is not considered in the ratings, but information about some of the soil properties that influence such performance is given in the descriptions of the soil series.

The ratings apply to the soil material between the A horizon and a depth of 5 to 6 feet. It is assumed that soil horizons will be mixed during excavation and spreading. Many soils have horizons of contrasting suitability within their profile. The estimated engineering properties in table 14 provide specific information about the nature of each horizon. This information can help determine the suitability of each horizon for roadfill.

Soils rated *good* are coarse grained. They have low shrink-swell potential and few cobbles and stones. They are at least moderately well drained and have slopes of 15 percent or less. Soils rated *fair* have a plasticity index of less than 15 and have other limiting features, such as moderate shrink-swell potential, moderately steep slopes, wetness, or many stones. If the thickness of suitable material is less than 3 feet, the entire soil is rated *poor*.

Sand and *gravel* are used in great quantities in many kinds of construction. The ratings in table 12 provide guidance as to where to look for probable sources and are based on the probability that soils in a given area contain sizable quantities of sand or gravel. A soil rated *good* or *fair* has a layer of suitable material at least 3 feet thick, the top of which is within a depth of 6 feet. Coarse fragments of soft bedrock material, such as shale and siltstone, are not considered to be sand and gravel. Fine-grained soils are not suitable sources of sand and gravel.

The ratings do not take into account depth to the water table or other factors that affect excavation of the material. Descriptions of grain size, kinds of minerals, reaction, and stratification are given in the soil series descriptions and in table 14.

Topsoil is used in areas where vegetation is to be established and maintained. Suitability is affected mainly by the ease of working and spreading the soil material in preparing a seedbed and by the ability of the soil material to support plantlife. Also considered is the damage that can result at the area from which the topsoil is taken.

The ease of excavation is influenced by the thickness of suitable material, wetness, slope, and amount of stones. The ability of the soil to support plantlife is determined by texture, structure, and the amount of soluble salts or toxic substances. Organic matter in the A1 or Ap horizon greatly increases the absorption and retention of moisture and nutrients. Therefore, the soil material from these horizons should be carefully preserved for later use.

Soils rated *good* have at least 16 inches of friable loamy material at their surface. They are free of stones and cobbles, are low in content of gravel, and have gentle slopes. They are low in soluble salts that can limit or prevent plant growth. They are naturally fertile or respond well to fertilizer. They are not so wet that excavation is difficult during most of the year.

Soils rated *fair* are loose sandy soils or firm loamy or clayey soils in which the suitable material is only 8 to 16 inches thick or soils that have appreciable amounts of gravel, stones, or soluble salt.

Soils rated *poor* are very sandy soils and very firm clayey soils; soils with suitable layers less than 8 inches thick; soils having large amounts of gravel, stones, or soluble salt; steep soils; and poorly drained soils.

Although a rating of *good* is not based entirely on high content of organic matter, a surface horizon is generally preferred for topsoil because of its organic-matter content. This horizon is designated as A1 or Ap in the soil series descriptions. The absorption and retention of moisture and nutrients for plant growth are greatly increased by organic matter.

Water management

Many soil properties and site features that affect water management practices have been identified in this soil survey. In table 13 soil and site features that affect use are indicated for each kind of soil. This information is significant in planning, installing, and maintaining water control structures.

Embankments, dikes, and levees require soil material that is resistant to seepage, erosion, and piping and has

favorable stability, shrink-swell potential, shear strength, and compaction characteristics. Large stones and organic matter in a soil downgrade the suitability of a soil for use in embankments, dikes, and levees.

Drainage of soil is affected by such soil properties as permeability; texture; depth to bedrock, hardpan, or other layers that affect the rate of water movement; depth to the water table; slope; stability of ditchbanks; susceptibility to flooding; salinity and alkalinity; and availability of outlets for drainage.

Irrigation is affected by such features as slope, susceptibility to flooding, hazards of water erosion and soil blowing, texture, presence of salts and alkali, depth of root zone, rate of water intake at the surface, permeability of the soil below the surface layer, available water capacity, need for drainage, and depth to the water table.

Soil properties

Extensive data about soil properties are summarized on the following pages. The two main sources of these data are the many thousands of soil borings made during the course of the survey and the laboratory analyses of selected soil samples from typical profiles.

In making soil borings during field mapping, soil scientists can identify several important soil properties. They note the seasonal soil moisture condition or the presence of free water and its depth. For each horizon in the profile, they note the thickness and color of the soil material; the texture, or amount of clay, silt, sand, and gravel or other coarse fragments; the structure, or the natural pattern of cracks and pores in the undisturbed soil; and the consistence of the soil material in place under the existing soil moisture conditions. They record the depth of plant roots, determine the pH or reaction of the soil, and identify any free carbonates.

Samples of soil material are analyzed in the laboratory to verify the field estimates of soil properties and to determine all major properties of key soils, especially properties that cannot be estimated accurately by field observation. Laboratory analyses are not conducted for all soil series in the survey area, but laboratory data for many soil series not tested are available from nearby survey areas.

The available field and laboratory data are summarized in tables. The tables give the estimated range of engineering properties, the engineering classifications, and the physical and chemical properties of each major horizon of each soil in the survey area. They also present data about pertinent soil and water features, engineering test data, and data obtained from physical and chemical laboratory analyses of soils.

Engineering properties

Table 14 gives estimates of engineering properties and classifications for the major horizons of each soil in the survey area.

Most soils have, within the upper 5 or 6 feet, horizons of contrasting properties. Table 14 gives information for each of these contrasting horizons in a typical profile. *Depth* to the upper and lower boundaries of each horizon is indicated. More information about the range in depth and about other properties in each horizon is given for each soil series in the section "Soil series and morphology."

Texture is described in table 14 in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in soil material that is less than 2 millimeters in diameter. "Loam," for example, is soil material that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If a soil contains gravel or other particles coarser than sand, an appropriate modifier is added, for example, "gravelly loam." Other texture terms are defined in the Glossary.

The two systems commonly used in classifying soils for engineering use are the Unified Soil Classification System (Unified) (*2*) and the system adopted by the American Association of State Highway and Transportation Officials (AASHTO) (*1*).

The *Unified* system classifies soils according to properties that affect their use as construction material. Soils are classified according to grain-size distribution of the fraction less than 3 inches in diameter, plasticity index, liquid limit, and organic-matter content. Soils are grouped into 15 classes—eight classes of coarse-grained soils, identified as GW, GP, GM, GC, SW, SP, SM, and SC; six classes of fine-grained soils, identified as ML, CL, OL, MH, CH, and OH; and one class of highly organic soils, identified as Pt. Soils on the borderline between two classes have a dual classification symbol, for example, CL-ML.

The *AASHTO* system classifies soils according to those properties that affect their use in highway construction and maintenance. In this system a mineral soil is classified in one of seven basic groups ranging from A-1 through A-7 on the basis of grain-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines. At the other extreme, in group A-7, are fine-grained soils. Highly organic soils are classified in group A-8 on the basis of visual inspection.

When laboratory data are available, the A-1, A-2, and A-7 groups are further classified as follows: A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, and A-7-6. As an additional refinement, the desirability of soils as subgrade material can be indicated by a group index number. These numbers range from 0 for the best subgrade material to 20 or higher for the poorest. The estimated

classification, without group index numbers, is given in table 14. Also in table 14 the percentage, by weight, of rock fragments more than 3 inches in diameter is estimated for each major horizon. These estimates are determined mainly by observing volume percentage in the field and then converting that, by formula, to weight percentage.

Percentage of the soil material less than 3 inches in diameter that passes each of four sieves (U.S. standard) is estimated for each major horizon. The estimates are based on tests of soils that were sampled in the survey area and in nearby areas and on field estimates from many borings made during the survey.

Liquid limit and *plasticity index* indicate the effect of water on the strength and consistence of soil. These indexes are used in both the Unified and AASHTO soil classification systems. They are also used as indicators in making general predictions of soil behavior. Range in liquid limit and plasticity index are estimated on the basis of test data from the survey area or from nearby areas and on observations of the many soil borings made during the survey.

In some surveys, the estimates are rounded to the nearest 5 percent. Thus, if the ranges of gradation and Atterburg limits extend a marginal amount across classification boundaries (1 or 2 percent), the classification in the marginal zone is omitted.

Physical and chemical properties

Table 15 shows estimated values for several soil characteristics and features that affect behavior of soils in engineering uses. These estimates are given for each major horizon, at the depths indicated, in the typical pedon of each soil. The estimates are based on field observations and on test data for these and similar soils.

Clay is a mineral soil particle that is less than 0.002 millimeters in diameter.

In table 15, the estimated clay content of each major soil horizon is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The amount and kind of clay greatly affect the fertility and physical condition of the soil. They determine the ability of the soil to adsorb cations and to retain moisture. They influence the soil's shrink-swell potential, permeability, and plasticity; the ease of soil dispersion; and other soil properties. The amount and kind of clay in a soil also affect tillage and earth-moving operations.

Permeability is estimated on the basis of known relationships among the soil characteristics observed in the field—particularly soil structure, porosity, and gradation or texture—that influence the downward movement of water in the soil. The estimates are for vertical water movement when the soil is saturated. Not considered in the estimates is lateral seepage or such transient soil features as plowpans and surface crusts. Permeability of the soil is an important factor to be considered in planning and designing drainage systems, in evaluating the potential of soils for septic tank systems and other waste disposal systems, and in many other aspects of land use and management.

Available water capacity is rated on the basis of soil characteristics that influence the ability of the soil to hold water and make it available to plants. Important characteristics are content of organic matter, soil texture, and soil structure. Shallow-rooted plants are not likely to use the available water from the deeper soil horizons. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design of irrigation systems.

Soil reaction is expressed as range in pH values. The range in pH of each major horizon is based on many field checks. For many soils, the values have been verified by laboratory analyses. Soil reaction is important in selecting the crops, ornamental plants, or other plants to be grown; in evaluating soil amendments for fertility and stabilization; and in evaluating the corrosivity of soils.

Salinity is expressed as the electrical conductivity of the saturation extract, in millimhos per centimeter at 25 degrees C. Estimates are based on field and laboratory measurements at representative sites of the nonirrigated soils. The salinity of individual irrigated fields is affected by the quality of the irrigation water and by the frequency of water application. Hence, the salinity of individual fields can differ greatly from the value given in table 15. Salinity affects the suitability of a soil for crop production, its stability when used as a construction material, and its potential to corrode metal and concrete.

Shrink-swell potential depends mainly on the amount and kind of clay in the soil. Laboratory measurements of the swelling of undisturbed clods were made for many soils. For others the swelling was estimated on the basis of the kind and amount of clay in the soil and on measurements of similar soils. The size of the load and the magnitude of the change in soil moisture content also influence the swelling of soils. Shrinking and swelling of some soils can cause damage to building foundations, basement walls, roads, and other structures unless special designs are used. A high shrink-swell potential indicates that special design and added expense may be required if the planned use of the soil will not tolerate large volume changes.

Erosion factors are used to predict the erodibility of a soil and its tolerance to erosion in relation to specific kinds of land use and treatment. The soil erodibility factor (K) is a measure of the susceptibility of the soil to erosion by water. Soils having the highest K values are the most erodible. K values range from 0.10 to 0.64. To estimate annual soil loss per acre, the K value of a soil is modified by factors representing plant cover, grade and length of slope, management practices, and climate. The soil-loss tolerance factor (T) is the maximum rate of soil erosion, whether from rainfall or soil blowing, that can occur without reducing crop production or environ-

mental quality. The rate is expressed in tons of soil loss per acre per year.

Wind erodibility groups are made up of soils that have similar porperties that affect their resistance to soil blowing if cultivated. The groups are used to predict the susceptibility of soil to blowing and the amount of soil lost as a result of blowing. Soils are grouped according to the following distinctions:

1. Sands, coarse sands, fine sands, and very fine sands. These soils are extremely erodible, so vegetation is difficult to establish. They are generally not suitable for crops.

2. Loamy sands, loamy fine sands, and loamy very fine sands. These soils are very highly erodible, but crops can be grown if intensive measures to control soil blowing are used.

3. Sandy loams, coarse sandy loams, fine sandy loams, and very fine sandy loams. These soils are highly erodible, but crops can be grown if intensive measures to control soil blowing are used.

4L. Calcareous loamy soils that are less than 35 percent clay and more than 5 percent finely divided calcium carbonate. These soils are erodible, but crops can be grown if intensive measures to control soil blowing are used.

4. Clays, silty clays, clay loams, and silty clay loams that are more than 35 percent clay. These soils are moderately erodible, but crops can be grown if measures to control soil blowing are used.

5. Loamy soils that are less than 18 percent clay and less than 5 percent finely divided calcium carbonate and sandy clay loams and sandy clays that are less than 5 percent finely divided calcium carbonate. These soils are slightly erodible, but crops can be grown if measures to control soil blowing are used.

6. Loamy soils that are 18 to 35 percent clay and less than 5 percent finely divided calcium carbonate, except silty clay loams. These soils are very slightly erodible, and crops can easily be grown.

7. Silty clay loams that are less than 35 percent clay and less than 5 percent finely divided calcium carbonate. These soils are very slightly erodible, and crops can easily be grown.

8. Stony or gravelly soils and other soils not subject to soil blowing.

Soil and water features

Table 16 contains information helpful in planning land uses and engineering projects that are likely to be affected by soil and water features.

Hydrologic soil groups are used to estimate runoff from precipitation. Soils not protected by vegetation are placed in one of four groups on the basis of the intake of water after the soils have been wetted and have received precipitation from long-duration storms.

The four hydrologic soil groups are:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist chiefly of deep, well drained to excessively drained sands or gravels. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils that have a layer that impedes the downward movement of water or soils that have moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clay soils that have a high shrink-swell potential, soils that have a permanent high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

Flooding is the temporary covering of soil with water from overflowing streams and with runoff from adjacent slopes. Water standing for short periods after rains is not considered flooding, nor is water in swamps and marshes. Flooding is rated in general terms that describe the frequency when flooding is most likely. The ratings are based on evidence in the soil profile of the effects of flooding, namely thin strata of gravel, sand, silt, or, in places, clay deposited by floodwater; irregular decrease in organic-matter content with increasing depth; and absence of distinctive soil horizons that form in soils of the area that are not subject to flooding. The ratings are also based on local information about floodwater levels in the area and the extent of flooding and on information that relates the position of each soil on the landscape to historic floods.

The generalized description of flood hazards is of value in land-use planning and provides a valid basis for land-use restrictions. The soil data are less specific, however, than those provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

Depth to bedrock is shown for all soils that are underlain by bedrock at a depth of 5 to 6 feet or less. For many soils, the limited depth to bedrock is a part of the definition of the soil series. The depths shown are based on measurements made in many soil borings and on other observations during the mapping of the soils. The kind of bedrock and its hardness as related to ease of excavation is also shown. Rippable bedrock can be excavated with a single-tooth ripping attachment on a 200-horsepower tractor, but hard bedrock generally requires blasting.

Cemented pans are hard subsurface layers, within a depth of 5 or 6 feet, that are strongly compacted (indurated). Such pans cause difficulty in excavation. The hardness of pans is similar to that of bedrock. A rippable pan can be excavated, but a hard pan generally requires blasting.

Risk of corrosion pertains to potential soil-induced chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to soil moisture, particle-size distribution, total acidity, and electrical conductivity of the soil material. The rate of corrosion of concrete is based mainly on the sulfate content, texture, and acidity of the soil. Protective measures for steel or more resistant concrete help to avoid or minimize damage resulting from the corrosion. Uncoated steel intersecting soil boundaries or soil horizons is more susceptible to corrosion than an installation that is entirely within one kind of soil or within one soil horizon.

Soil series and morphology

In this section, each soil series recognized in the survey area is described in detail. The descriptions are arranged in alphabetic order by series name.

Characteristics of the soil and the material in which it formed are discussed for each series. The soil is then compared to similar soils and to nearby soils of other series. Then a pedon, a small three-dimensional area of soil that is typical of the soil series in the survey area, is described. The detailed descriptions of each soil horizon follow standards in the Soil Survey Manual (*10*). Unless otherwise noted, colors described are for dry soil.

Following the pedon description is the range of important characteristics of the soil series in this survey area. Phases, or map units, of each soil series are described in the section "Soil maps for detailed planning."

Antho series

The Antho series consists of deep, well drained soils on flood plains and low terraces. These soils formed in mixed, sandy alluvium. Slope is 0 to 2 percent. Mean annual precipitation ranges from 2 to 4 inches, and mean annual air temperature ranges from 72 to 76 degrees F.

Antho soils are similar to Gilman, Indio, Lagunita, and Vint soils. They are near Dateland, Gilman, Indio, Lagunita, and Vint soils. Lagunita soils have sand throughout the control section. Dateland soils have a cambic horizon. Gilman and Indio soils are medium textured. Vint soils have loamy fine sand and strata of finer texture in the control section.

Typical pedon of Antho fine sandy loam, about 3 miles south of Antelope Hill; about 2,100 feet south and 150 feet east of the northwest corner of sec. 9, T. 9 S., R. 17 W.:

A1—0 to 3 inches; light yellowish brown (10YR 6/4) fine sandy loam, yellowish brown (10YR 5/6) moist; moderate thin platy structure; soft, very friable; many very fine roots; many very fine vesicular pores; strongly effervescent; moderately alkaline; clear wavy boundary.

C1—3 to 8 inches; light yellowish brown (10YR 6/4) gravelly sandy loam, yellowish brown (10YR 5/6) moist; massive; soft, very friable; many very fine roots; many very fine tubular pores; 15 percent fine pebbles; strongly effervescent; moderately alkaline; clear wavy boundary.

C2—8 to 18 inches; light yellowish brown (10YR 6/4) gravelly coarse sandy loam, dark yellowish brown (10YR 4/4) moist; massive; soft, very friable; few fine and many very fine roots; many very fine tubular pores; 20 percent fine pebbles; strongly effervescent; moderately alkaline; clear smooth boundary.

C3—18 to 38 inches; brownish yellow (10YR 6/6) gravelly sandy loam, yellowish brown (10YR 5/6) moist; massive; soft, very friable; common very fine and few fine roots; few fine tubular and many very fine interstitial pores; 15 percent fine pebbles; strongly effervescent; strongly alkaline; clear wavy boundary.

C4—38 to 50 inches; brownish yellow (10YR 6/6) coarse sandy loam, yellowish brown (10YR 5/6) moist; massive; soft, very friable; few very fine roots; many very fine tubular pores; 5 percent fine pebbles; strongly effervescent; strongly alkaline; clear wavy boundary.

C5—50 to 60 inches; brownish yellow (10YR 6/6) sandy loam, yellowish brown (10YR 5/6) moist; massive; slightly hard, very friable, slightly sticky; few very fine roots; many very fine tubular pores: 5 percent fine pebbles; violently effervescent; moderately alkaline.

The 10- to 40-inch control section is less than 35 percent coarse fragments. The A horizon is fine sandy loam or sandy loam. The C horizon is light yellowish brown and brownish yellow gravelly sandy loam, gravelly coarse sandy loam, coarse sandy loam, fine sandy loam, or sandy loam.

Carrizo series

The Carrizo series consists of deep, excessively drained soils on flood plains and recent alluvial fans of the major streams and intermittent washes. These soils formed in recent, mixed, alluvial deposits. Slope is 0 to 9 percent. Mean annual precipitation ranges from 2 to 4 inches, and mean annual air temperature ranges from 72 to 76 degrees F.

Carrizo soils are similar to Lagunita, Rositas, and Vint soils and are near Cristobal, Harqua, Ligurta, and Tre-

mant soils. All of these soils, except Ligurta soils, average less than 35 percent coarse fragments in the control section. Lagunita soils average loamy sand or sand in the control section. Rositas soils do not have any strata that are loamy very fine sand or finer. Vint soils average loamy fine sand in the control section and have strata of finer texture. Cristobal, Harqua, Ligurta, and Tremant soils have an argillic horizon.

Typical pedon of Carrizo very gravelly sand, about 4 miles east and 4 1/2 miles north of Wellton; about 330 feet west and 2,750 feet north of the southeast corner of sec. 11, T. 8 S., R. 18 W.:

A11—0 to 1 inch; light brown (7.5YR 6/4) very gravelly sand, brown (7.5YR 5/4) moist; single grain; loose; many fine interstitial pores; 40 percent fine and medium pebbles; strongly effervescent; moderately alkaline; abrupt wavy boundary.

A12—1 to 3 inches; light brown (7.5YR 6/4) very gravelly sand, brown (7.5YR 5/4) moist; weak very thin and medium platy structure; slightly hard, very friable; few fine roots; few fine tubular pores; 35 percent fine and medium pebbles; slightly effervescent; moderately alkaline; clear smooth boundary.

C1—3 to 6 inches; pink (7.5YR 7/4) gravelly loamy sand, brown (7.5YR 5/4) moist; weak very thin and thin platy structure; slightly hard, very friable; many very fine roots; few fine tubular pores; 20 percent fine and medium pebbles; slightly effervescent; moderately alkaline; clear wavy boundary.

C2—6 to 13 inches; light brown (7.5YR 6/4) very gravelly sand, brown (7.5YR 5/4) moist; massive; soft, very friable; many very fine and fine roots; many very fine interstitial pores and few very fine and fine tubular pores; 40 percent fine and medium pebbles; slightly effervescent; moderately alkaline; clear irregular boundary.

IIC3—13 to 16 inches; pink (7.5YR 7/4) loam, brown (7.5YR 5/4) moist; massive; slightly hard, very friable; slightly sticky and slightly plastic; common very fine and fine roots; many very fine interstitial pores; 10 percent fine pebbles; slightly effervescent; moderately alkaline; clear wavy boundary.

IIIC4—16 to 35 inches; pink (7.5YR 7/4) very gravelly sand, brown (7.5YR 5/4) moist; massive; slightly hard, very friable, common very fine and fine roots; many very fine interstitial pores; 40 percent fine and medium pebbles; slightly effervescent; moderately alkaline; clear smooth boundary.

IIIC5—35 to 64 inches; pink (7.5YR 7/4) very gravelly coarse sand, brown (7.5YR 5/4) moist; massive; slightly hard, very friable; common very fine roots; many very fine interstitial pores; 35 percent fine and medium pebbles; slightly effervescent; moderately alkaline.

The A horizon is very gravelly sand or very gravelly loamy sand and is 35 to 40 percent pebbles.

Cherioni series

The Cherioni series consists of very shallow and shallow, well drained soils on volcanic hills and mountains. These soils have a silica- and lime-cemented duripan. They formed in mixed residuum and colluvium. Slope is 25 to 70 percent. Mean annual precipitation ranges from 2 to 4 inches, and mean annual air temperature ranges from 72 to 76 degrees F.

Cherioni soils are similar to Cristobal, Gachado, Harqua, Ligurta, and Tremant soils. Cristobal, Harqua, Ligurta, and Tremant soils all have an argillic horizon and are more than 60 inches deep to bedrock. Gachado soils also have an argillic horizon, but do not have a duripan.

Typical pedon of a Cherioni extremely cobbly loam in an area of Cherioni-Rock outcrop complex, 25 to 70 percent slopes; about 800 feet west and 300 feet north of the southeast corner of sec. 12, T. 5 S., R. 11 W.:

A1—0 to 6 inches; light yellowish brown (10YR 6/4) extremely cobbly loam, dark yellowish brown (10YR 4/4) moist; weak thin platy structure; soft, very friable, slightly sticky and slightly plastic; many very fine roots; many very fine tubular pores; 90 percent basalt cobbles; strongly effervescent; moderately alkaline; clear wavy boundary.

C1ca—6 to 13 inches; very pale brown (10YR 7/3) extremely gravelly loam, light yellowish brown (10YR 6/4) moist; massive; slightly hard, friable, sticky and plastic; many very fine roots; many very fine tubular pores; 70 percent fine and medium pebbles; 15 percent cobbles; strongly effervescent; moderately alkaline; clear wavy boundary.

C2sicam—13 to 15 inches; white (10YR 8/1) silica- and lime-cemented duripan, very pale brown (10YR 7/3) moist; massive; extremely hard; strongly effervescent; moderately alkaline; abrupt wavy boundary.

R—15 inches; extremely hard basalt bedrock.

The control section is 50 to 90 percent coarse fragments. The C1 horizon is very pale brown or light yellowish brown extremely gravelly loam or very gravelly loam. The hardpan is at a depth of 5 to 20 inches. Unweathered bedrock is at a depth of 6 to 20 inches.

Cristobal series

The Cristobal series consists of deep, well drained, strongly saline soils on broad old alluvial fans and low terraces. These soils formed in very gravelly alluvium weathered from andesite, rhyolite, and basalt. Mean annual precipitation ranges from 2 to 4 inches, and mean annual air temperature ranges from 72 to 76 degrees F.

Cristobal soils are similar to Ligurta and Tremant soils. They are near Antho, Carrizo, Lagunita, Ligurta, and Tremant soils. Antho, Carrizo, and Lagunita soils do not have an argillic horizon. Ligurta and Tremant soils are less than 35 percent rock fragments.

Typical pedon of a Cristobal very gravelly loam in an area of Ligurta-Cristobal complex, 2 to 6 percent slopes; about 14 miles north-northwest of Dateland; about 1,100 feet west and 1,000 feet south of the northeast corner of sec. 28, T. 5 S., R. 13 W.:

A2—0 to 2 inches; pale brown (10YR 6/3) very gravelly loam, dark brown (10YR 3/3) moist; moderate thin and medium platy structure; slightly hard, very friable, slightly sticky and slightly plastic; many very fine vesicular pores; 60 percent fine and medium pebbles; strongly effervescent; moderately alkaline; gradual wavy boundary.

B1tcasa—2 to 6 inches; red (2.5YR 5/6) very gravelly clay loam, dark red (2.5YR 3/6) moist; weak very fine crumb structure; soft, very friable, sticky and plastic; many fine interstitial pores; few thin clay films on faces of peds; 35 percent fine pebbles; few fine and medium soft lime masses, undersides of pebbles coated with lime; strongly saline; strongly effervescent; moderately alkaline; clear wavy boundary.

B21tcasa—6 to 10 inches; yellowish red (5YR 5/6) very gravelly clay loam, dark reddish brown (5YR 3/3) moist; weak fine crumb structure; soft, very friable, sticky and plastic; many very fine interstitial pores; few to common thin clay films on faces of peds; 50 percent fine and medium pebbles; common fine and medium soft lime masses, undersides of pebbles coated with lime; strongly saline; strongly effervescent; moderately alkaline; clear wavy boundary.

B22tcasa—10 to 17 inches; yellowish red (5YR 4/6) extremely gravelly clay loam, dark reddish brown (5YR 3/4) moist; weak fine and medium subangular blocky structure; slightly hard, very friable, sticky and plastic; many very fine tubular pores; few thin clay films on faces of peds and lining tubular pores; 70 percent fine pebbles; common and many fine and medium soft lime masses, undersides of pebbles coated with lime; strongly saline; strongly effervescent; moderately alkaline; abrupt wavy boundary.

B23tcasa—17 to 25 inches; yellowish red (5YR 5/6) very gravelly sandy clay loam, dark reddish brown (5YR 3/4) moist; weak fine subangular blocky structure; slightly hard, very friable, sticky and slightly plastic; many very fine tubular pores; few thin clay films on faces of peds and lining pores; 60 percent fine pebbles; common fine and medium soft lime masses; strongly saline; strongly effervescent; moderately alkaline; clear wavy boundary.

B24tcasa—25 to 35 inches; reddish yellow (7.5YR 6/6) very gravelly clay loam, dark brown (7.5YR 4/4) moist; weak fine subangular blocky structure; slightly hard, very friable, sticky and slightly plastic; many very fine tubular pores; few thin clay films lining tubular pores; 60 percent fine pebbles; many fine and medium soft lime masses; strongly saline; strongly effervescent; moderately alkaline; clear wavy boundary.

B3tcasa—35 to 60 inches; light brown (7.5YR 6/4) very gravelly clay loam, brown (7.5YR 5/4) moist; weak fine subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; many very fine tubular pores; few thin clay films lining tubular pores; 60 percent fine pebbles; strongly saline; strongly effervescent; moderately alkaline.

About 90 to 95 percent of the surface is covered with basalt pebbles (desert pavement). The solum is 15 to 60 inches thick. Rock fragments make up from 30 to 90 percent of the control section, but the weighed average is more than 35 percent. The profile is moderately alkaline, is strongly effervescent to violently effervescent, and is strongly saline throughout. The A horizon is reddish yellow to pale brown. The B2t horizon is very gravelly clay loam, extremely gravelly clay loam, very gravelly sandy clay loam, or gravelly clay loam.

Dateland series

The Dateland series consists of deep, well drained soils on old alluvial fans. These soils formed in mixed alluvial deposits weathered from granite, schist, gneiss, and sandstone. Slope is 0 to 3 percent. Mean annual precipitation ranges from 2 to 4 inches, and mean annual air temperature ranges from 72 to 76 degrees F.

Dateland soils are similar to Harqua, Ligurta, Tremant, and Wellton soils. They are near Antho, Cristobal, Lagunita, and Rositas soils. Harqua and Ligurta soils have an argillic horizon and are saline and strongly saline, respectively. Tremant soils have a gravelly clay loam argillic horizon. Wellton soils have a gravelly sandy loam argillic horizon. Cristobal soils have an argillic horizon and are more than 35 percent gravel. Antho, Lagunita, and Rositas soils are sandy and do not have a cambic horizon.

Typical pedon of Dateland fine sandy loam, about 1,200 feet north and 50 feet west of the southwest corner of sec. 33, T. 8 S., R. 17 W.:

Ap—0 to 6 inches; brown (10YR 5/3) fine sandy loam, dark brown (10YR 4/3) moist; massive; soft, very friable, slightly sticky and nonplastic; many fine and very fine roots; many fine and very fine tubular pores; slightly effervescent; moderately alkaline; abrupt smooth boundary.

B21—6 to 17 inches; light yellowish brown (10YR 6/4) fine sandy loam, dark yellowish brown (10YR 4/4) moist; massive; slightly hard, very friable, slightly

sticky and slightly plastic; few fine and very fine roots; many fine and very fine tubular pores; strongly effervescent; moderately alkaline; clear smooth boundary.

B22ca—17 to 27 inches; light yellowish brown (10YR 6/4) fine sandy loam, dark yellowish brown (10YR 4/4) moist; weak and moderate fine and medium subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; few fine and very fine roots; many fine and very fine tubular pores; few to common fine pinkish white (5YR 8/2) soft masses of lime; strongly effervescent; moderately alkaline; clear smooth boundary.

C1ca—27 to 54 inches; pale brown (10YR 6/3) loam, dark brown (10YR 4/3) moist; massive; soft, very friable, slightly sticky and slightly plastic; common fine and very fine roots; many fine and very fine tubular pores; few fine and medium pinkish white (7.5YR 8/2) soft lime masses and lime nodules; violently effervescent; moderately alkaline; clear wavy boundary.

C2ca—54 to 60 inches; pale brown (10YR 6/3) fine sandy loam, dark brown (10YR 4/3) moist; massive; soft, very friable, slightly sticky and nonplastic; few fine and common very fine roots; many fine and very fine tubular pores; few fine pinkish white (7.5YR 8/2) lime nodules; strongly effervescent; moderately alkaline.

The Ap horizon commonly is fine sandy loam or loamy fine sand, but in places it is slightly finer or coarser in texture. The B2 horizon commonly is fine sandy loam or loam and is less than 18 percent clay. It is less than 15 percent coarse fragments.

Gachado series

The Gachado series consists of very shallow and shallow, well drained soils on low hills and on toe slopes of mountains. These soils formed in residuum over basalt, andesite, and tuff. Slope is 2 to 8 percent. Mean annual precipitation ranges from 2 to 4 inches, and mean annual air temperature ranges from 72 to 76 degrees F.

Gachado soils are similar to or are near Cristobal, Laposa, Ligurta, and Tremant soils. Cristobal, Ligurta, and Tremant soils do not have bedrock at a depth of less than 60 inches. Laposa soils do not have an argillic horizon.

Typical pedon of Gachado very gravelly loam; about 4 miles east of Aztec; 1,300 feet north and 100 feet west of the southeast corner of sec. 1, T. 7 S., R. 11 W.:

A2—0 to 1 inch; pink (7.5YR 7/4) very gravelly loam, dark brown (7.5YR 4/4) moist; moderate thin platy structure; slightly hard, very friable, slightly sticky and slightly plastic; many fine and very fine vesicular pores; 50 percent fine and medium pebbles; strongly effervescent; moderately alkaline; abrupt wavy boundary.

B21tca—1 to 6 inches; pink (7.5YR 7/4) extremely gravelly sandy clay loam, yellowish red (5YR 4/6) moist; moderate fine subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; many fine and very fine tubular pores; few thin clay films lining pores and on faces of peds; violently effervescent; 80 percent lime coated cobbles and pebbles; moderately alkaline; clear wavy boundary.

B22tca—6 to 12 inches; reddish yellow (5YR 6/6) extremely gravelly loam, yellowish red (5YR 4/6) moist; weak fine subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; many very fine tubular pores; few thin clay films on faces of peds and lining pores; violently effervescent; 65 percent lime coated pebbles and cobbles; moderately alkaline; abrupt wavy boundary.

R—12 inches; extremely hard basalt bedrock that has a thin coating of pinkish white lime on the upper surface.

Pebbles and some cobbles cover 50 to 100 percent of the surface. The thickness of the solum and the depth to bedrock range from 9 to 20 inches. The B2t horizon is clay loam, sandy clay loam, or loam and is 50 to 80 percent coarse fragments (30 to 40 percent pebbles and 30 to 50 percent cobbles).

Gadsden series

The Gadsden series consists of deep, well drained soils on flood plains and low terraces. These soils formed in mixed fine-textured alluvium. Slope is less than 1 percent. Mean annual precipitation ranges from 2 to 4 inches, and mean annual air temperature ranges from 72 to 76 degrees F.

Gadsden soils are similar to Holtville, Glenbar, and Kofa soils. They are near Glenbar, Holtville, Kofa, Indio, and Ripley soils. Glenbar soils have a fine-silty control section. Holtville soils have a clayey over loamy control section. Kofa soils have sand at a depth of 20 to 40 inches. Indio soils have a coarse-silty control section. Ripley soils have a coarse-silty over sandy control section.

Typical pedon of Gadsden clay, about 2 miles north of Somerton; about 1,500 feet east and 1,300 feet south of the northwest corner of sec. 27, T. 9 S., R. 24 W.:

Ap1—0 to 10 inches; brown (10YR 5/3) clay, dark brown (10YR 3/3) moist; massive; very hard, firm, very sticky and very plastic; few fine roots; few fine tubular pores; few fine interstitial pores; strongly effervescent; moderately alkaline; clear smooth boundary.

Ap2—10 to 16 inches; brown (10YR 5/3) clay, dark brown (10YR 3/3) moist; massive; very hard, very

firm, very sticky and very plastic; few very fine tubular pores; strongly effervescent; moderately alkaline; slightly saline; clear wavy boundary.

C1—16 to 22 inches; very pale brown (10YR 7/4) heavy silty clay loam, yellowish brown (10YR 5/4) moist; massive; slightly hard, friable, sticky and plastic; few very fine tubular pores; many pressure faces in pores; strongly effervescent; moderately alkaline; slightly saline; clear wavy boundary.

C2—22 to 60 inches; light brown (7.5YR 6/4) clay, brown (7.5YR 4/4) moist; massive; very hard, very firm, very sticky and very plastic; few very fine tubular pores; many pressure faces in pores; strongly effervescent; moderately alkaline; moderately saline.

The control section is clay, silty clay, or heavy clay loam and is more than 35 percent clay. Some pedons have common pressure faces and slickensides.

Gilman series

The Gilman series consists of deep, well drained soils on flood plains, alluvial fans, and low terraces. These soils formed in alluvium weathered from granite, andesite, and rhyolite. Slope is 0 to 3 percent. Mean annual precipitation ranges from 2 to 4 inches, and mean annual air temperature ranges from 72 to 76 degrees F.

Gilman soils are similar to Antho, Indio, and Vint soils. They are near Antho, Glenbar, Indio, Lagunita, and Vint soils. Antho soils have a sandy loam control section. Glenbar soils have a fine-silty control section. Indio soils have a coarse-silty control section that is stratified in texture. Lagunita soils have a sandy control section. Vint soils are sandy.

Typical pedon of Gilman loam, about 1/2 mile north of Wellton; about 1,200 feet east and 100 feet north of Avenue 29E and 10th Street, in sec. 32, T. 8 S., R. 18 W.:

Ap1—0 to 6 inches; light yellowish brown (10YR 6/4) loam, dark yellowish brown (10YR 4/4) moist; massive; slightly hard, very friable, slightly sticky and slightly plastic; many fine and very fine roots; many fine tubular pores; strongly effervescent; moderately alkaline; abrupt smooth boundary.

Ap2—6 to 15 inches; very pale brown (10YR 7/4) loam, dark yellowish brown (10YR 4/4) moist; massive; slightly hard, very friable, slightly sticky and slightly plastic; many fine and very fine tubular pores; strongly effervescent; moderately alkaline; abrupt smooth boundary.

C1—15 to 24 inches; very pale brown (10YR 7/4) very fine sandy loam, dark yellowish brown (10YR 4/4) moist; massive; soft, very friable; many fine and very fine roots; many fine tubular pores; slightly effervescent; moderately alkaline; clear smooth boundary.

C2—24 to 60 inches; very pale brown (10YR 7/4) fine sandy loam, dark yellowish brown (10YR 4/4) moist; massive; soft, very friable; many fine tubular pores; slightly effervescent; moderately alkaline.

The A horizon is more than 15 percent fine and coarser sand and is less than 18 percent clay. The C horizon has strata of silty clay loam to sand less than 2 inches thick.

Glenbar series

The Glenbar series consists of deep, well drained soils on flood plains and low terraces. These soils formed in mixed alluvium weathered from andesite, rhyolite, basalt, and granite. Slope is less than 1 percent. Mean annual precipitation ranges from 2 to 4 inches, and mean annual air temperature ranges from 72 to 76 degrees F.

Glenbar soils are similar to Gadsden, Holtville, and Indio soils. They are near Gadsden, Gilman, Holtville, and Indio soils. Gadsden soils are clayey to a depth of more than 40 inches. Holtville soils are clayey over loamy at a depth of 20 to 40 inches. Gilman soils have a coarse-loamy control section. Indio soils have a coarse-silty control section.

Typical pedon of Glenbar silty clay loam, about 3 miles northeast of Wellton; about 3,075 feet south and 500 feet west of the northeast corner of sec. 34, T. 8 S., R. 18 W.:

Ap1—0 to 5 inches; pale brown (10YR 6/3) silty clay loam, yellowish brown (10YR 5/4) moist; massive; hard, friable, slightly sticky and slightly plastic; many very fine roots; common very fine tubular pores; violently effervescent; moderately alkaline; clear smooth boundary.

Ap2—5 to 10 inches; brown (10YR 5/3) silty clay loam, dark brown (10YR 4/3) moist; massive; hard, friable, slightly sticky and slightly plastic; many very fine roots; few very fine tubular pores; violently effervescent; moderately alkaline; clear smooth boundary.

Ap3—10 to 16 inches; pale brown (10YR 6/3) silty clay loam, brown (7.5YR 5/4) moist; massive; hard, friable, slightly sticky and slightly plastic; common very fine roots; many very fine tubular pores; violently effervescent; moderately alkaline; abrupt wavy boundary.

C1—16 to 31 inches; light yellowish brown (10YR 6/4) silty clay loam, yellowish brown (10YR 5/4) moist; weak very thin platy structure; slightly hard, friable, slightly sticky and slightly plastic; few very fine roots; few fine tubular pores; violently effervescent; moderately alkaline; clear wavy boundary.

C2—31 to 42 inches; pale brown (10YR 6/3) silty clay loam, brown (10YR 4/3) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; few very fine roots; few fine tubular pores; strongly effer-

vescent; moderately alkaline; gradual wavy boundary.

C3—42 to 60 inches; very pale brown (10YR 7/3) silty clay loam, brown (10YR 4/3) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; common very fine roots; few fine and common very fine tubular pores; strongly effervescent; strongly alkaline.

The A horizon is brown, light brown, or pale brown. The C horizon is pale brown, very pale brown, or light yellowish brown and has thin strata of finer or coarser texture.

Harqua series

The Harqua series consists of deep, well drained soils on old alluvial fans and low terraces. These soils formed in old alluvium weathered from andesite, rhyolite, and basalt. Slope is 0 to 4 percent. Mean annual precipitation ranges from 2 to 4 inches, and mean annual air temperature ranges from 72 to 76 degrees F.

Harqua soils are similar to Cristobal, Dateland, Ligurta, Tremant, and Wellton soils. They are near Antho, Carrizo, and Rositas soils. Cristobal and Ligurta soils have a salic horizon and a loamy-skeletal control section. Dateland and Wellton soils have a coarse-loamy control section. Ligurta soils are fine-loamy. Tremant soils are not saline. Antho, Carrizo, and Rositas soils do not have an argillic horizon.

Typical pedon of a Harqua gravelly loam in an area of Harqua-Tremant complex, about 7 miles north of Tacna; 300 feet east and 100 feet north of the southwest corner of sec. 14, T. 8 S., R. 15 W.:

Ap1—0 to 3 inches; light brown (7.5YR 6/4) gravelly loam, brown (7.5YR 5/4) moist; weak thin platy structure; slightly hard, very friable, slightly sticky and slightly plastic; common fine roots; many very fine interstitial pores; 35 percent fine and medium pebbles; strongly effervescent; moderately alkaline; clear wavy boundary.

Ap2—3 to 5 inches; light brown (7.5YR 6/4) gravelly loam, brown (7.5YR 5/4) moist; massive; soft, very friable, slightly sticky and slightly plastic; common fine and few medium roots; many fine interstitial pores; 30 percent fine and medium pebbles; strongly effervescent; moderately alkaline; abrupt wavy boundary.

B21tca—5 to 13 inches; yellowish red (5YR 4/6) gravelly clay loam, yellowish red (5YR 4/6) moist; weak fine and medium subangular blocky structure; slightly hard, very friable, sticky and plastic; few fine and medium roots; many fine interstitial pores; 30 percent fine and medium pebbles; violently effervescent; moderately alkaline; gradual wavy boundary.

B22tca—13 to 32 inches; yellowish red (5YR 5/6) gravelly clay loam, yellowish red (5YR 4/6) moist; weak fine and medium subangular blocky structure; hard, friable, sticky and plastic; few fine tubular and many fine interstitial pores; few soft lime masses; 20 percent fine and medium pebbles; violently effervescent; moderately alkaline; clear wavy boundary.

B23tca—32 to 43 inches; brown (7.5YR 5/4) clay loam, yellowish red (5YR 4/6) moist; weak fine and medium subangular blocky structure; hard, friable, sticky and plastic; few fine and many very fine tubular pores; many soft lime masses; 5 percent fine pebbles; violently effervescent; moderately alkaline; clear wavy boundary.

B24tca—43 to 60 inches; reddish brown (5YR 5/4) clay loam, yellowish red (5YR 4/6) moist; weak fine and medium subangular blocky structure; hard, friable, sticky and plastic; many fine interstitial pores; few fine soft lime masses; 5 percent fine pebbles; violently effervescent; moderately alkaline.

The control section is 5 to 35 percent coarse fragments, mainly fine pebbles. The content of pebbles decreases with depth. The argillic horizon is gravelly clay loam, gravelly loam, gravelly sandy clay loam, or clay loam.

Holtville series

The Holtville series consists of deep, well drained soils on flood plains. These soils formed in mixed alluvium weathered from andesite, rhyolite, and granite. Slope is 0 to 1 percent. Mean annual precipitation ranges from 2 to 4 inches, and mean annual air temperature ranges from 72 to 76 degrees F.

Holtville soils are similar to Gadsden, Glenbar, and Kofa soils. They are near Gadsden, Glenbar, Indio, Kofa, Lagunita, Ripley, Rositas, and Vint soils. Gadsden soils have a clayey control section. Kofa and Ripley soils have sand below a depth of 20 inches. Glenbar soils have a fine-silty control section. Indio soils have a coarse-silty control section. Lagunita, Rositas, and Vint soils have a sandy control section.

Typical pedon of Holtville clay, about 2 1/2 miles northwest of Somerton; about 1,900 feet north and 100 feet west of intersection of Avenue B and County 14 Street, in sec. 20, T. 9 S., R. 24 W.:

Ap—0 to 13 inches; pale brown (10YR 6/3) clay, dark brown (10YR 4/3) moist; massive; hard, firm, very sticky and very plastic; fine and very fine roots; many very fine interstitial pores; strongly effervescent; moderately alkaline; clear smooth boundary.

C1—13 to 23 inches; pale brown (10YR 6/3) clay, dark brown (10YR 3/3) moist; massive; hard, firm, very sticky and very plastic; many fine and very fine

roots; many very fine interstitial pores; strongly effervescent; moderately alkaline; abrupt wavy boundary.

IIC2—23 to 32 inches; very pale brown (10YR 7/3) very fine sandy loam, brown (10YR 5/3) moist; massive; slightly hard, very friable, slightly sticky and slightly plastic; few coarse and common fine and very fine roots; many fine and very fine tubular and interstitial pores; strongly effervescent; moderately alkaline; abrupt smooth boundary.

IIIC3—32 to 37 inches; very pale brown (10YR 7/3) silty clay loam, brown (10YR 5/3) moist; massive; slightly hard, friable, sticky and plastic; few coarse and common fine and very fine roots; many very fine interstitial pores; strongly effervescent; strongly alkaline; abrupt smooth boundary.

IVC4—37 to 75 inches; light yellowish brown (10YR 6/4) very fine sandy loam, yellowish brown (10YR 5/4) moist; massive; slightly hard, very friable, slightly sticky and slightly plastic; few coarse and common fine and very fine roots; few fine tubular pores; strongly effervescent; moderately alkaline.

In places these soils are moderately saline or strongly saline. The layers between depths of 10 and 36 inches are dominantly silty clay or clay. The material below the clay or silty clay is dominantly very fine sandy loam, but some thick strata are silt loam or loamy fine sand.

Indio series

The Indio series consists of deep, well drained soils on flood plains and alluvial fans of the Colorado and Gila Rivers and in some of the larger drainageways. These soils formed in mixed alluvium weathered from rhyolite, andesite, and granite. Slope is 0 to 2 percent. Mean annual precipitation ranges from 2 to 4 inches, and mean annual air temperature ranges from 72 to 76 degrees F.

Indio soils are similar to Antho, Gilman, and Glenbar soils. They are near Antho, Gilman, Glenbar, Kofa, Lagunita, Ripley, and Vint soils. Antho and Gilman soils are coarse-loamy. Glenbar soils are fine-silty. Lagunita and Vint soils are sandy. Ripley soils have sand or loamy sand at a depth of 20 to 40 inches. Kofa soils are clayey over sandy.

Typical pedon of Indio silt loam, about 2 miles northeast of Antelope Hill; about 1,200 feet east and 75 feet south of the northwest corner of sec. 15, T. 8 S., R. 17 W.:

Ap—0 to 2 inches; light brown (7.5YR 6/4) silt loam, dark brown (7.5YR 4/4) moist; weak very thin and thin platy structure; slightly hard, very friable, slightly sticky and slightly plastic; few fine roots; many very fine interstitial pores; violently effervescent; moderately alkaline; abrupt smooth boundary.

Ap2—2 to 6 inches; light brown (7.5YR 6/4) silt loam, dark brown (7.5YR 4/4) moist; weak very thin and thin platy structure; slightly hard, very friable, slightly sticky and slightly plastic; common fine and very fine roots; few very fine tubular pores; violently effervescent; moderately alkaline; abrupt smooth boundary.

C1—6 to 63 inches; light brown (7.5YR 6/4) silt loam, dark brown (7.5YR 4/4) moist; very weak very thin platy structure; slightly hard, very friable, slightly sticky and slightly plastic; few fine and common very fine roots; few fine and very fine tubular pores; violently effervescent; moderately alkaline.

The 10- to 40-inch control section is stratified. It is dominantly very fine sandy loam, silt loam, or silt. It is less than 18 percent clay and is less than 15 percent sand that is fine sand and coarser. The profile is moderately saline to strongly saline.

Kofa series

The Kofa series consists of deep, well drained soils on flood plains and low terraces of the Colorado and Gila Rivers. These soils formed in mixed alluvium. Slope is 0 to 1 percent. Mean annual precipitation ranges from 2 to 4 inches, and mean annual air temperature ranges from 72 to 76 degrees F.

Kofa soils are similar to Gadsden, Glenbar, and Holtville soils. They are near Gadsden, Glenbar, Holtville, Indio, Lagunita, Ripley, Rositas, and Vint soils. Gadsden soils are clayey throughout. Holtville soils are clayey over loamy. Glenbar soils are fine-silty. Indio soils are coarse-silty. Ripley soils are coarse-silty over sandy. Lagunita, Rositas, and Vint soils are sandy.

Typical pedon of Kofa clay in Yuma Valley, about 2,000 feet south and 250 feet east of the northwest corner of sec. 3, T. 10 S., R. 24 W., 1/2 mile south of the intersection of Avenue F and U.S. Highway 95, near Somerton:

Ap—0 to 12 inches; pale brown (10YR 6/3) clay, brown (10YR 4/3) moist; strong fine, medium, and coarse blocky structure; hard, firm, very sticky and plastic; few fine roots; many fine tubular pores; violently effervescent; moderately alkaline; clear smooth boundary.

C1—12 to 28 inches; pale brown (10YR 6/3) clay, brown (10YR 5/3) moist; moderate very thin and thin platy structure; hard, firm, very sticky and plastic; few fine and very fine roots; many fine and common very fine tubular pores; violently effervescent; moderately alkaline; abrupt smooth boundary.

IIC2—28 to 60 inches; very pale brown (10YR 7/4) sand, yellowish brown (10YR 5/4) moist; single grain; loose; many fine interstitial pores; slightly effervescent; moderately alkaline.

The A horizon is light brown or pale brown. The IIC2 horizon is sand or loamy sand. Depth to underlying sand ranges from 20 to 36 inches.

Lagunita series

The Lagunita series consists of deep, somewhat excessively drained soils on flood plains, low terraces, and alluvial fans and in drainageways. These soils formed in mixed sandy alluvium. Slope is 0 to 3 percent. Mean annual precipitation ranges from 2 to 4 inches, and mean annual air temperature ranges from 72 to 76 degrees F.

Lagunita soils are similar to Carrizo, Rositas, Superstition, and Vint soils. They are near Antho, Gilman, Glenbar, Indio, Ripley, and Vint soils. Carrizo soils average more than 35 percent gravel in the control section. Rositas soils are more than 15 percent coarse and very coarse sand. Superstition soils have a calcic horizon. Vint soils average loamy fine sand in the control section and are stratified with sandy material. Antho, Gilman, Glenbar, Indio, and Ripley soils all average sandy loam or finer in the control section.

Typical pedon of Lagunita loamy sand, 1,800 feet south and 2,200 feet east of the southeast corner of sec. 24, T. 8 S., R. 17 W.:

A1—0 to 8 inches; pale brown (10YR 6/3) loamy sand, dark brown (10YR 3/3) moist; single grain; loose; many very fine roots; many very fine interstitial pores; slightly effervescent; moderately alkaline; clear wavy boundary.

C1—8 to 30 inches; pale brown (10YR 6/3) loamy sand, dark brown (10YR 3/3) moist; single grain; loose; many very dark roots; many very fine interstitial pores; slightly effervescent; moderately alkaline; clear wavy boundary.

C2—30 to 60 inches; pale brown (10YR 6/3) loamy sand, dark brown (10YR 4/3) moist; single grain; loose; many very fine roots; many very fine interstitial pores; slightly effervescent; moderately alkaline.

The A horizon is loamy sand or silt loam. The C horizon is loamy fine sand, loamy sand, or sand. The control section is less than 15 percent coarse fragments and is less than 15 percent coarse and very coarse sand.

Laposa series

The Laposa series consists of moderately deep, well drained soils on hills and mountains. These soils formed in extremely gravelly residuum derived from granite, gneiss, schist, andesite, and rhyolite. Slope is 20 to 85 percent. Mean annual precipitation ranges from 2 to 4 inches, and mean annual air temperature ranges from 72 to 76 degrees F.

Laposa soils are similar to Carrizo, Cherioni, Cristobal, and Gachado soils. They are near Carrizo, Cristobal, Gachado, and Ligurta soils. Carrizo soils have very gravelly sand in the control section. Cherioni soils have a duripan and are shallow. Cristobal, Gachado, and Ligurta soils have an argillic horizon.

Typical pedon of a Laposa extremely gravelly loam in an area of Laposa-Rock outcrop complex, 15 to 75 percent slopes; in the Trigo Mountains, about 15 miles north of Imperial Dam; about 1,000 feet west and 1,750 feet south of the northeast corner of sec. 18, T. 4 S., R. 22 E.:

A1—0 to 3 inches; yellowish brown (10YR 5/4) extremely gravelly loam, dark yellowish brown (10YR 4/4) moist; weak thin platy structure; soft, very friable, slightly sticky and nonplastic; many very fine roots; many very fine tubular and interstitial pores; 90 percent pebbles; violently effervescent; moderately alkaline; abrupt smooth boundary.

C1—3 to 10 inches; light yellowish brown (10YR 6/4) extremely gravelly loam, dark yellowish brown (10YR 4/4) moist; massive; soft, very friable, slightly sticky and slightly plastic; many very fine roots; few very fine tubular and many very fine interstitial pores; 70 percent pebbles; violently effervescent; moderately alkaline; abrupt wavy boundary.

C2—10 to 21 inches; light yellowish brown (10YR 6/4) extremely gravelly loam, dark yellowish brown (10YR 4/4) moist; massive; soft, very friable, slightly sticky and slightly plastic; many very fine roots; many very fine interstitial pores; 70 percent pebbles; violently effervescent; moderately alkaline; clear wavy boundary.

C3—21 to 32 inches; light yellowish brown (10YR 6/4) extremely gravelly loam, dark yellowish brown (10YR 4/4) moist; massive; soft, very friable, slightly sticky and slightly plastic; few very fine roots; many fine interstitial pores; 80 percent coarse pebbles of decomposed granite; violently effervescent; moderately alkaline; abrupt wavy boundary.

R—32 inches; extremely hard granitic bedrock.

Pebbles, cobbles, and boulders cover 60 to 100 percent of the surface. Depth to bedrock ranges from 20 to 40 inches. Rock fragment content in the control section ranges from 50 to 90 percent.

Ligurta series

The Ligurta series consists of deep, well drained, strongly saline soils on old alluvial fans and low terraces. These soils formed in alluvium weathered from andesite, rhyolite, and basalt. Slope is 2 to 6 percent. Mean annual precipitation ranges from 2 to 4 inches, and mean annual air temperature ranges from 72 to 76 degrees F.

Ligurta soils are similar to Cristobal and Tremant soils. They are near Carrizo, Cristobal, Dateland, Indio, Rositas, Tremant, and Wellton soils. Cristobal soils have a loamy-skeletal control section. Tremant soils do not have a salic horizon and are fine-loamy. Dateland and Wellton soils do not have a salic horizon and are coarse-loamy. Carrizo, Indio, and Rositas soils do not have an argillic horizon.

Typical pedon of a Ligurta very gravelly loam in an area of Ligurta-Cristobal complex, 2 to 6 percent slopes; about 2,000 feet east and 500 feet north of the northeast corner of sec. 23, T. 5 S., R. 12 W.:

A2—0 to 2 inches; very pale brown (10YR 7/4) very gravelly loam, dark yellowish brown (10YR 4/4) moist; moderate medium platy structure; slightly hard, very friable, slightly sticky and slightly plastic; few very fine roots; few very fine vesicular pores; 50 percent fine and medium pebbles; strongly effervescent; moderately alkaline; abrupt smooth boundary.

B21tcasa—2 to 5 inches; reddish yellow (7.5YR 7/6) gravelly clay loam, dark reddish brown (5YR 3/4) moist; crumb structure; soft, very friable, sticky and plastic; few very fine roots; many very fine tubular pores; 15 percent fine pebbles; strongly effervescent; strongly saline; moderately alkaline; clear wavy boundary.

B22tcasa—5 to 10 inches; yellowish red (5YR 4/6) gravelly clay loam, dark reddish brown (5YR 3/4) moist; crumb structure; soft, very friable, sticky and plastic; few very fine roots; many very fine interstitial pores; common soft lime masses; 20 percent fine and medium pebbles; strongly saline; strongly effervescent; moderately alkaline; clear wavy boundary.

B23tcasa—10 to 15 inches; yellowish red (5YR 5/6) gravelly clay loam, dark reddish brown (5YR 3/4) moist; weak fine and medium subangular blocky structure; slightly hard, friable, sticky and plastic; many very fine tubular pores; common thin clay films on faces of peds and lining pores; 25 percent fine and medium pebbles; common very fine salt crystals; strongly saline; common soft lime masses; strongly effervescent; moderately alkaline; clear wavy boundary.

B24tcasa—15 to 28 inches; light reddish brown (5YR 6/3) clay loam, reddish brown (5YR 4/3) moist; moderate fine and medium subangular blocky structure; hard, friable, sticky and plastic; many very fine tubular pores; few thin clay films on faces of peds and lining pores; common very fine salt crystals; 10 percent fine and medium pebbles; common soft lime masses; strongly saline; violently effervescent; moderately alkaline; clear wavy boundary.

B25tcasa—28 to 40 inches; light reddish brown (5YR 6/3) gravelly clay loam, reddish brown (5YR 4/3) moist; moderate fine and medium subangular blocky structure; hard, friable, sticky and plastic; many very fine tubular pores; few thin clay films on faces of peds and lining pores; common very fine salt crystals; 15 percent fine pebbles; common soft lime masses; strongly saline; strongly effervescent; moderately alkaline; gradual wavy boundary.

B3tcasa—40 to 60 inches; light reddish brown (5YR 6/3) gravelly loam, reddish brown (5YR 4/3) moist; massive; hard, friable, slightly sticky and slightly plastic; few very fine tubular pores; few thin clay films on faces of peds and lining pores; common very fine salt crystals; common soft lime masses; 15 percent fine pebbles; strongly saline; strongly effervescent; moderately alkaline.

Varnished gravel (desert pavement) covers 90 to 95 percent of the surface. The solum is 30 to 60 inches thick. Coarse fragments make up as much as 35 percent of the control section. Reaction ranges from moderately alkaline to very strongly alkaline. The electrical conductivity of a saturated extract exceeds 20 millimhos and is dominantly more than 35 millimhos. The A2 horizon is very pale brown and brown. The argillic horizon is gravelly clay loam, gravelly sandy clay loam, gravelly loam, or clay loam.

Ripley series

The Ripley series consists of deep, well drained soils on flood plains and low terraces. These soils formed in mixed alluvium weathered from granite, andesite, and rhyolite. Slope is 0 to 1 percent. Mean annual precipitation ranges from 2 to 4 inches, and mean annual air temperature ranges from 72 to 76 degrees F.

Ripley soils are near Gadsden, Holtville, Indio, Kofa, Lagunita, and Vint soils. Lagunita and Vint soils have a sandy control section. Indio soils are coarse-silty. Gadsden, Holtville, and Kofa soils have clay in the control section.

Typical pedon of Ripley silt loam in an irrigated area about 1.5 miles west of Texas Hill; about 0.5 mile east and 0.3 mile north of the southwest corner of sec. 8, T. 7 S., R. 14 W.:

Ap—0 to 6 inches; light brown (7.5YR 6/4) silt loam, brown (7.5YR 4/4) moist; moderate thick platy structure; slightly hard, very friable, slightly sticky and slightly plastic; many fine roots; common fine tubular pores; strongly effervescent; moderately alkaline; abrupt smooth boundary.

C1—6 to 25 inches; pale brown (10YR 6/4) very fine sandy loam, brown (10YR 4/3) moist; massive; slightly hard, very friable, slightly sticky and slightly plastic; common fine roots; strongly effervescent; moderately alkaline; abrupt wavy boundary.

IIC2—25 to 60 inches; pale brown (10YR 6/4) sand, brown (10YR 4/3) moist; massive; soft, very friable;

few fine roots; many fine interstitial pores; slightly effervescent; moderately alkaline.

Sand or loamy sand is at a depth of 20 to 36 inches. The upper part of the control section averages silt loam or very fine sandy loam and is highly stratified with various textures.

Rositas series

The Rositas series consists of deep, somewhat excessively drained soils on terraces, alluvial fans, and sand dunes. These soils formed in mixed, sandy, windblown material. Slope is 0 to 20 percent. Mean annual precipitation ranges from 2 to 4 inches, and mean annual air temperature ranges from 72 to 76 degrees F.

Rositas soils are similar to Lagunita, Superstition, and Vint soils. They are near Dateland, Cristobal, Lagunita, Ligurta, Superstition, Tremant, Vint, and Wellton soils. Lagunita soils have less than 15 percent coarse or very coarse sand in the control section. Vint soils have strata that are loamy very fine sand or finer. Superstition soils have a calcic horizon. Dateland soils have a cambic horizon and a coarse-loamy control section. Ligurta, Cristobal, Tremant, and Wellton soils have an argillic horizon.

Typical pedon of Rositas sand in an area of Tremant-Rositas complex; about 3 miles north of Dateland on Avenue 64E and about 1 mile west of Avenue 64E in the southwest corner of sec. 1, T. 7 S., R. 13 W.:

A1—0 to 5 inches; light brown (7.5YR 6/4) sand, dark brown (7.5YR 4/4) moist; single grain; loose; common fine and few very fine roots; slightly effervescent; moderately alkaline; clear smooth boundary.

C1—5 to 60 inches; light brown (7.5YR 6/4) sand, dark brown (7.5YR 4/4) moist; single grain; loose; few fine and medium roots; slightly effervescent; moderately alkaline.

These soils are slightly effervescent to strongly effervescent. Lime is generally disseminated, but in some pedons it is in small segregations. The control section is sand or loamy sand and is less than 15 percent coarse fragments.

Superstition series

The Superstition series consists of deep, somewhat excessively drained soils on old terraces of the Colorado River. These soils formed in mixed sandy alluvium. Slope is 0 to 3 percent. Mean annual precipitation ranges from 2 to 4 inches, and mean annual air temperature ranges from 72 to 76 degrees F.

Superstition soils are similar to Lagunita, Rositas, and Vint soils. They are near Cristobal, Dateland, Lagunita, Rositas, Tremant, and Vint soils. Lagunita, Rositas, and Vint soils have a sandy control section but do not have a calcic horizon. Dateland soils have a cambic horizon and a coarse-loamy control section. Cristobal and Tremant soils have an argillic horizon.

Typical pedon of Superstition sand, about 3 1/2 miles east of San Luis; 1,500 feet west of the east quarter corner of sec. 9, T. 9 S., R. 24 W.:

A1—0 to 5 inches; light brown (7.5YR 6/4) sand, brown (7.5YR 5/4) moist; weak thin platy structure on immediate surface, single grain below; loose; common fine and very fine roots; many fine interstitial pores; 3 percent fine pebbles; strongly effervescent; moderately alkaline; clear wavy boundary.

C1—5 to 23 inches; light brown (7.5YR 6/4) sand, brown (7.5YR 5/4) moist; massive; soft, very friable; common fine and very fine roots; many fine interstitial and few fine tubular pores; 3 percent fine pebbles; few fine soft white lime masses; strongly effervescent; moderately alkaline; clear wavy boundary.

C2ca—23 to 42 inches; light brown (7.5YR 6/4) sand, brown (7.5YR 5/4) moist; massive; soft, very friable; few fine roots; many fine interstitial pores; 2 percent fine pebbles; common fine white lime masses and nodules; violently effervescent; moderately alkaline; clear wavy boundary.

C3ca—42 to 60 inches; pink (7.5YR 7/4) sand, brown (7.5YR 5/4) moist; massive; soft, very friable; many fine interstitial pores; few fine soft white lime masses; strongly effervescent; moderately alkaline.

Depth to the calcic horizon ranges from 14 to 30 inches. Texture throughout the profile is sand or loamy sand. The Cca horizon has few to many soft lime masses and nodules and averages less than 15 percent calcium carbonate.

In the vicinity of Avenue B and County 17 Street, siltation from the use of Colorado River water for irrigation has resulted in the deposition of a 10-inch-thick layer of fine textured material, dominantly clay, sandy clay loam, and loam. This area was mapped as Superstition complex.

Tremant series

The Tremant series consists of deep, well drained soils on old alluvial fans and low terraces. These soils formed in mixed alluvium. Slope is 0 to 5 percent. Mean annual precipitation ranges from 2 to 4 inches, and mean annual air temperature ranges from 72 to 76 degrees F.

Tremant soils are similar to Cristobal, Dateland, Harqua, Ligurta, and Wellton soils. They are near Antho, Carrizo, and Rositas soils. Cristobal and Ligurta soils have a salic horizon. Dateland and Wellton soils have a coarse-loamy control section. Harqua soils are saline

and have a fine-loamy control section. Antho, Carrizo, and Rositas soils do not have an argillic horizon.

Typical pedon of a Tremant loam in an area of Harqua-Tremant complex; about 6 miles north of Hyder, 200 feet north and 2,000 feet west of the southeast corner of sec. 36, T. 3 S., R. 11 W.:

Ap—0 to 12 inches; light brown (7.5YR 6/4) loam, dark brown (7.5YR 4/4) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; many very fine tubular pores; 5 percent fine pebbles; strongly effervescent; moderately alkaline; clear wavy boundary.

B1tca—12 to 23 inches; brown (7.5YR 5/4) gravelly sandy clay loam, dark brown (7.5YR 4/4) moist; weak fine and medium subangular blocky structure; hard, friable, sticky and slightly plastic; many very fine roots; many very fine tubular pores; many very fine soft lime masses; 25 percent fine pebbles; violently effervescent; moderately alkaline; abrupt wavy boundary.

B21tca—23 to 37 inches; brown (7.5YR 5/4) gravelly clay loam, dark brown (7.5YR 4/4) moist; moderate fine and medium subangular blocky structure; hard, friable, sticky and plastic; many very fine roots; many very fine tubular pores; many very fine soft lime masses; 25 percent fine pebbles; violently effervescent; moderately alkaline; clear wavy boundary.

B22tca—37 to 60 inches; dark brown (7.5YR 4/4) gravelly clay loam, dark brown (7.5YR 4/4) moist; moderate fine and medium subangular blocky structure; hard, friable, sticky and plastic; few very fine roots; many very fine tubular pores; many very fine soft lime masses; 15 percent fine pebbles; violently effervescent; moderately alkaline.

The control section is 5 to 35 percent coarse fragments, mainly fine pebbles. The Bt horizon is loam, sandy clay loam, clay loam, gravelly loam, gravelly sandy clay loam, or gravelly clay loam.

Vint series

The Vint series consists of deep, well drained soils on flood plains and low terraces. These soils formed in mixed sandy alluvium weathered from igneous and sedimentary rocks. Slope is 0 to 1 percent. Mean annual precipitation ranges from 2 to 4 inches, and mean annual air temperature ranges from 72 to 76 degrees F.

Vint soils are similar to Lagunita, Rositas, Superstition, and Carrizo soils. They are near Gilman, Indio, and Lagunita soils. Lagunita and Rositas soils have a sand or loamy sand control section. Carrizo soils have a sandy-skeletal control section. Superstition soils have a calcic horizon. Gilman soils have a coarse-loamy control section and Indio soils have a coarse-silty control section.

Typical pedon of Vint loamy fine sand; about 5 miles northwest of Wellton; about 2,200 feet east and 700 feet north of the southwest corner of sec. 32, T. 9 S., R. 19 W.:

Ap—0 to 16 inches; pale brown (10YR 6/3) loamy fine sand, dark brown (10YR 3/3) moist; massive; slightly hard, friable; many very fine roots; many very fine interstitial pores; slightly effervescent; moderately alkaline; clear wavy boundary.

C1—16 to 32 inches; light brownish gray (10YR 6/2) loamy fine sand, dark brown (10YR 4/3) moist; single grain; loose; common very fine roots; many very fine tubular pores; slightly effervescent; moderately alkaline; abrupt wavy boundary.

IIC2—32 to 34 inches; light yellowish brown (10YR 6/4) silt loam, dark brown (10YR 3/3) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; few very fine roots; few very fine tubular pores; slightly effervescent; moderately alkaline; abrupt wavy boundary.

IIIC3—34 to 42 inches; pale brown (10YR 6/3) loamy fine sand, dark brown (10YR 4/3) moist; massive; soft, very friable; common very fine roots; few very fine tubular pores; strongly effervescent; moderately alkaline; abrupt wavy boundary.

IVC4—42 to 58 inches; light yellowish brown (10YR 6/4) silt loam, dark brown (10YR 3/3) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; few very fine roots; few very fine tubular pores; violently effervescent; moderately alkaline; clear wavy boundary.

VC5—58 to 60 inches; pale brown (10YR 6/3) silty clay loam, dark brown (10YR 3/3) moist; massive; hard, friable, sticky and plastic; few very fine roots; few very fine tubular pores; violently effervescent; moderately alkaline.

Vint soils commonly are nongravelly, but some horizons are as much as 35 percent pebbles. Variable amounts of mica flakes are scattered throughout the profile. The A horizon is pale brown or light brownish gray. The C horizon is light brownish gray, light yellowish brown, or pale brown loamy fine sand and commonly contains clay balls throughout. Common thin strata of silt loam, silty clay loam, or clay loam 1/8 inch to 3 inches thick occur through the C horizon.

Wellton series

The Wellton series consists of deep, well drained soils on old alluvial fans and high terraces. These soils formed in mixed alluvium weathered from granite, gneiss, and sandstone. Slope is 0 to 3 percent. Mean annual precipitation ranges from 2 to 4 inches, and mean annual air temperature ranges from 72 to 76 degrees F.

Wellton soils are similar to Cristobal, Dateland, Harqua, and Tremant soils. They are near Antho, Cristobal, Dateland, Harqua, Lagunita, Ligurta, Rositas, and Tremant soils. Dateland soils have a cambic horizon and are less than 15 percent coarse fragments. Harqua and Tremant soils have a gravelly clay loam subsoil. Cristobal and Ligurta soils have a salic horizon, and Cristobal soils are more than 35 percent coarse fragments in the control section. Antho, Lagunita, and Rositas soils do not have an argillic horizon.

Typical pedon of Wellton loamy sand, about 3 miles south and 3.8 miles west of Wellton; about 1,500 feet east and 30 feet north of the southwest corner of sec. 22, T. 9 S., R. 19 W.:

A1—0 to 8 inches; light brown (7.5YR 6/4) loamy sand, brown (7.5YR 5/4) moist; weak thin and medium platy structure; soft, very friable; few very fine and fine roots; strongly effervescent; moderately alkaline; clear smooth boundary.

B21tca—8 to 17 inches; light brown (7.5YR 6/6) fine gravelly sandy loam, strong brown (7.5YR 5/6) moist; weak and moderate fine and medium subangular blocky structure; slightly hard, very friable; few very fine, fine, and coarse roots; many fine interstitial and few fine tubular pores; 30 percent fine pebbles; colloidal stains and clay occur as bridges between sand grains; common fine irregularly shaped soft masses of lime; violently effervescent; moderately alkaline; clear wavy boundary.

B22tca—17 to 29 inches; reddish yellow (5YR 6/6) fine gravelly sandy loam, yellowish red (5YR 5/6) moist; weak and moderate fine and medium subangular blocky structure; slightly hard, very friable; few fine and medium roots; many fine interstitial and few fine tubular pores; 30 percent fine pebbles; colloidal stains and clay occur as bridges between sand grains; common fine irregularly shaped soft masses of lime; violently effervescent; moderately alkaline; gradual wavy boundary.

B23tca—29 to 51 inches; reddish yellow (5YR 6/6) fine gravelly sandy loam, yellowish red (5YR 5/6) moist; weak and moderate fine and medium subangular blocky structure; slightly hard, very friable; many fine interstitial and few fine tubular pores; about 25 percent fine pebbles; colloidal stains and clay occur as bridges between sand grains; common medium and large irregularly shaped soft masses of lime; violently effervescent; moderately alkaline; clear wavy boundary.

C1ca—51 to 60 inches; light brown (7.5YR 6/4) fine gravelly coarse sandy loam, brown (7.5YR 5/4) moist; massive; slightly hard, very friable; many interstitial pores; about 20 percent fine pebbles; violently effervescent; moderately alkaline.

The A horizon is dominantly loamy sand. The argillic horizon is sandy loam or loam and is 15 to 35 percent coarse fragments.

Classification

The system of soil classification currently used was adopted by the National Cooperative Soil Survey in 1965. Readers interested in further details about the system should refer to "Soil taxonomy" (*12*).

The system of classification has six categories. Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. In this system the classification is based on the different soil properties that can be observed in the field or those that can be inferred either from other properties that are observable in the field or from the combined data of soil science and other disciplines. The properties selected for the higher categories are the result of soil genesis or of factors that affect soil genesis. In table 17, the soils of the survey area are classified according to the system. Categories of the system are discussed in the following paragraphs.

ORDER. Ten soil orders are recognized as classes in the system. The properties used to differentiate among orders are those that reflect the kind and degree of dominant soil-forming processes that have taken place. Each order is identified by a word ending in *sol*. An example is Entisol.

SUBORDER. Each order is divided into suborders based primarily on properties that influence soil genesis and are important to plant growth or that are selected to reflect the most important variables within the orders. The last syllable in the name of a suborder indicates the order. An example is Fluvent (*Flu*, meaning flood plain sediment, plus *ent*, from Entisol).

GREAT GROUP. Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of expression of pedogenic horizons; soil moisture and temperature regimes; and base status. Each great group is identified by the name of a suborder and a prefix that suggests something about the properties of the soil. An example is Torrifluvents (*Torri*, meaning hot and dry, plus *fluvent*, the suborder of Entisols that formed in flood plain sediment.

SUBGROUP. Each great group may be divided into three subgroups: the central (typic) concept of the great groups, which is not necessarily the most extensive subgroup; the intergrades, or transitional forms to other orders, suborders, or great groups; and the extragrades, which have some properties that are representative of the great groups but do not indicate transitions to any other known kind of soil. Each subgroup is identified by one or more adjectives preceding the name of the great group. The adjective *Typic* identifies the subgroup that is

thought to typify the great group. An example is Typic Torrifluvents.

FAMILY. Families are established within a subgroup on the basis of similar physical and chemical properties that affect management. Among the properties considered in horizons of major biological activity below plow depth are particle-size distribution, mineral content, temperature regime, thickness of the soil penetrable by roots, consistence, moisture equivalent, soil slope, and permanent cracks. A family name consists of the name of a subgroup and a series of adjectives. The adjectives are the class names for the soil properties used as family differentiae. An example is coarse-loamy, mixed (calcareous), hyperthermic, Typic Torrifluvents.

SERIES. The series consists of soils that formed in a particular kind of material and have horizons that, except for texture of the surface soil or of the underlying substratum, are similar in differentiating characteristics and in arrangement in the soil profile. Among these characteristics are color, texture, structure, reaction, consistence, and mineral and chemical composition.

Formation of the soils

In this section, the processes of soils formation and geomorphology and geology are discussed and related to the soils in the survey area.

Factors of soil formation

Soil is a natural, dynamic body on the surface of the earth in which plants grow. The soil mantle on the earth's surface is far from uniform, but all soils have some things in common. They all consist of mineral material, organic matter, living organisms, water, and air, all of which occur in varying amounts in different soils.

Soil is the result of an accumulation of parent material and the action of environmental forces upon this material to form distinctive layers, or horizons. These forces work independently or together in various combinations to bring about the end results—soil.

The soil properties are determined by the interaction of five major soil-forming factors. These factors are parent material, climate, relief, plants and animals, and time. The influence of these soil-forming factors varies widely over the surface of the earth. Variations in climate, combinations of living organisms, kinds of rock, topography, and age of land surfaces result in thousands of combinations of the soil-forming factors. The resulting combinations control the basic changes that determine the characteristics of the soil. These changes, including removals, transfers, additions, and transformations, depend on physical and chemical processes that are continuously taking place.

These changes within the soil determine the horizon differentiation in the profile. The degree of horizon development determines the age, or maturity, of the soil. Thus, a soil lacking horizon development is a young, or immature, soil. On the other hand, a soil that has well expressed horizons is an older, or more mature, soil.

The five major soil-forming factors and their influence on the basic soil changes and the development of soils in the survey are described in the section that follows.

Parent material

Parent material must be chemically or physically weathered to produce soil material. The kinds of material produced by weathering are determined by the composition and structure of the original rock. Most rocks are a mixture of several minerals. Plant nutrients are released and clay minerals generally are formed by weathering, but in some rocks that have a high content of relatively inert minerals, such as quartz, little besides mechanical breakdown results from the weathering process.

The elements released influence soil fertility levels, the kinds of plants that grow, soil color, chemical reaction, and various other soil properties that differentiate soil horizons.

About half of the soils in the survey area formed in material derived from various kinds of bedrock and in old alluvium. The bedrock includes granite, schist, gneiss, andesite, rhyolite, basalt, and sandstone. The remaining soils formed in alluvium, most of which was derived from the weathering of a mixture of several of the kinds of rock named above.

The physical properties of the parent material are strongly reflected in some soils. An example is the Cherioni soils. These soils have horizons that exhibit structure very similar to that of the parent rock. In other soils, such as the Tremant, Harqua, Dateland, and Wellton soils, most of the physical characteristics of the parent material have been obscured during weathering. Cristobal soils have some horizon cementation, which reflects the calcareous mineralogy of the parent material or, perhaps, calcareous additions from dust.

Climate

Climate affects soil formation through its influence on vegetation, on weathering, and on runoff and erosion. The main climatic factors that affect soil formation are precipitation and temperature.

The climate of this area is characterized by hot summers, mild winters, and very little rainfall. Presumably, it is similar to the climate under which most of the soils of Holocene age formed. The climate is considered to have been more cool and moist during the Pleistocene. Additional climatic data for this area are given in the "Climate" section.

A hot, dry climate restricts the rate of soil formation. The process of soil formation in alluvium begins when water percolates through it. Translocation of humus, iron, manganese, and clay may then occur. Low rainfall

delays this leaching and the subsequent development of distinct horizons. The soils of the Holocene flood plains and recent alluvial fans, such as the Antho and Indio soils, therefore show little or no evidence of illuviation. The very high temperatures in summer also contribute to oxidation of the organic matter, so that the organic matter content of the soils in this area is very low.

Relief

Relief controls water runoff and drainage. In general, on the steeper slopes runoff is greater and less moisture is retained in the soil. Therefore, steep soils are less weathered because moisture is essential in the weathering process. In some places soils that have steep slopes are eroded at about the same rate or at a greater rate than material is weathered from the parent rock. This results in bedrock at the surface or in soils that are shallow over bedrock and have only thin horizons. The Cherioni soils are an example of such soils.

On the more nearly level areas, water enters the profile, weathering takes place, nutrients are released, plants grow, and micro-organisms multiply. In these areas, soils such as the Harqua, Cristobal, and Gachado soils form.

Recent alluvium has been deposited along the Colorado and Gila Rivers and in the larger drainageways, and such soils as the Gilman, Lagunita, Ripley, Indio, Glenbar, Vint, and Antho have formed in this material.

Plants and animals

Plants, animals, insects, bacteria, and fungi affect the formation of soils by increasing the organic matter content of the soils, producing gains or losses in plant nutrients, and changing structure and porosity.

In this survey area, biological effects began after the stratified alluvial deposits were sufficiently drained to support plants and animals. Through the combined activities of living organisms, the river deposits became more mixed, acquired a more open structure, and developed a heterogeneous pore system that is conducive to still further and stronger biological activity.

Time

The time available for a soil to form in unconsolidated sediment is the time that has elapsed since the final deposition of the parent material. In general, it takes much more time for the accumulation of parent material than it does for the horizons in the soil to develop. The soils in the survey area that formed in material derived from consolidated sedimentary and igneous rocks began to develop after the parent rock weathered into permeable material.

The unconsolidated sediment was deposited during the later Tertiary and Quaternary Periods. It ranges in age from mid-Pliocene to Recent. Soils such as the Gachado, Harqua, and Tremant soils were forming during the Pleistocene. Soils such as the Antho, Indio, Ripley, Glenbar, Gilman, Lagunita, Vint, Gadsden, Holtville, and Kofa still receive periodic surficial deposits, and therefore soil formation in these soils has barely begun.

Geomorphology and geology

The survey area is characterized geomorphically by low, northwest-trending mountains that are separated by much more extensive desert plains. Through these plains are cut the present valleys of the Colorado and Gila Rivers. There are seven major types of landscape in the survey area: (1) mountains and hills, (2) dissected old river deposits, (3) dissected piedmont slopes, (4) undissected piedmont slopes, (5) river terraces and mesas, (6) sand dunes, and (7) river valleys.

The mountains and hills are composed of dense crystalline rock of pre-Tertiary age. Hard volcanic rock of Tertiary age forms the higher, more rugged exposures, and less consolidated sedimentary and volcanic rock of Tertiary age forms the lower, more rounded hills. Some of the mountain blocks are buried by alluvium, particularly those in the southern and western parts of the area.

The dissected piedmont slopes, which are characterized by extensive desert pavement and are cut by numerous washes, are along the margins of the hills and mountains.

The undissected piedmont slopes, also near the hills and mountains, are distinguished from the older, dissected piedmont slopes by a general absence of desert pavement and by the shallow depth of incision of the most recent washes.

The river terraces and mesas are remnants of an extensive former valley and delta plain of the Colorado River and its major tributary, the Gila River. The surfaces of the terraces and mesas generally lie about 60 to 80 feet above the present river valleys, but in the extreme western part of the area the terrace surfaces slope west or southwest toward the axis of the Salton Trough and at gradients steeper than those of the river valleys (*6*). Yuma Mesa represents the principal river terrace in the area. Others are Wellton Mesa and several distinct smaller terraces that extend upstream along both the Gila and the Colorado Rivers.

As a result of the entrenchment of the Colorado and Gila Rivers, the Wellton Mesa is 60 to 70 feet and the Yuma Mesa is 70 to 80 feet above the adjacent Wellton-Mohawk and South Gila Valleys. Extensive river terraces at similar elevations occur farther upstream on both the Colorado and the Gila Rivers (*5*). In places—for example, at Laguna Dam, Imperial Dam, and the Gila River narrows between the Gila and Laguna Mountains—the terraces are cut in pre-Tertiary rock or in Tertiary sedimentary or volcanic rock. However, the terraces may have been formed since the time of the last major higher sea level stand during the Sangamon Interglaciation (*3, 13*). The last sea level stand significantly above the pres-

ent level occurred about 120,000 years ago. Below this point the width of the valley and its decreased gradient permitted the meandering river to deposit sediment from the Gila Mountains.

Three terraces are on the Yuma Mesa. The dominant material of the terraces is typically fluvial gravel, sand, and silt that are overlain in places by eolian deposits. Representative drill samples in the terraces reveal silty clay that has sand streaks and is about 55 percent clay, 30 percent silt, and 15 percent sand. The composition of the material constitutes a cross section of all the material eroded by the river. The sands have resisted weathering so that the terraces are composed primarily of loose and rapidly permeable sandy soils classified as Superstition sand, Superstition complex, and Rositas sand.

The geomorphology of the Yuma Mesa is very similar to that of the East Mesa (*4, 7*), which lies between the Imperial Valley and the California Sand Hills. Similar mesas or terraces occur in the Wellton-Mohawk and Dateland-Aztec areas. The soils in these mesa areas are similar. The Wellton Mesa has two soils that do not occur on the Yuma Mesa—the Wellton and Dateland soils, which extend easterly to Mohawk. The river valleys are the Holocene flood plains of the Colorado and Gila Rivers. Most areas of the flood plains are farmed and have not been subject to flooding since dams were constructed upstream and levees were built along the Colorado River in the Yuma area. The flood plains are bordered by terraces and higher coalesced fan piedmonts, which were dissected before the aggradational cycle that produced the present flood plains.

The Colorado and Gila Rivers have dominated the geologic history of the area. Faulting and volcanism are known to have begun in the Mesozoic Era. Sedimentation in the Colorado and Gila Rivers Valleys was probably greatest during the Pleistocene Epoch. It was during this epoch that the mountains of Colorado, Utah, and Wyoming had large alpine glaciers, whose melting brought great quantities of outwash. During this same epoch, the precipitation was several times that of the present. The precipitation, combined with the effect of the glacial outwash, caused extensive erosion. The Colorado and Gila Rivers have transported into this area alluvium derived from erosion in seven states. This sediment has filled the deep trough of the Gulf of California.

Diastrophism during the Triassic Period formed a huge depression known as the Gulf of California, an extension of the Pacific Ocean (*8*). During the Pleistocene Epoch, great icecaps advanced and retreated over the northern part of the North American Continent. The combined effect of huge quantities of glacial melt water and climatic aspects of colder temperatures and higher precipitation contributed to the development of this area.

"Laguna Valley" is the informal name given to the flood plain of the Colorado River between the Laguna and Imperial Dams. It is the first broad flood plain along the river downstream from the Cibola area. In its present form it is not a natural feature but is a surface of aggradation caused by the Laguna Dam. An estimated 14 feet of aggradation has occurred behind the Laguna Dam. The soils between the Laguna and Imperial Dams are Salorthids, nearly level. These are very salic soils typical of wet places in the desert, where capillary rise and evaporation of water concentrate the salts in a salic horizon. Laguna Valley is occupied by phreatophytes and hydrophytes, and much of it is covered by shallow water.

At the end of the Pleistocene Epoch the flow of the Gila River decreased. The stream gradually eroded a deeper channel into the earlier sedimentary deposits and shifted northward, forming the present flood plain and valley of the Gila River. The Gila River has very little fall, and the channel is not firmly established. As a result, the River has meandered a great deal during the various floods. In 1941 it changed its course in many places and deposited silt and sand. The Gila River, which drains the southern half of Arizona, presently joins the Colorado River just a few miles east of the City of Yuma. Concurrently with the valley development of the Gila River flood plain areas, known locally as the Wellton-Mohawk Valley and the Gila Valley, the Colorado River was incising the Yuma Mesa to form the present Yuma Valley. The Colorado River formed the three terraces of the Yuma Mesa, and the Gila River formed the terraces known as the Wellton-Mohawk, Dateland, and Aztec Mesas.

The Gila River, which also discharges into the apex of the Colorado Delta, has a contributory role in the development of the delta. Although the Gila River has contributed only a small amount of sediment in modern times, it is believed that during some periods of deltaic deposition the Gila River carried a greater volume of sediment than did the Colorado River (*9*). The ancestral Colorado River delta, now a terrace between the Yuma Mesa and the Yuma Valley and between the Yuma Mesa and the Gila River flood plain, is for the most part rough, steep, and highly dissected from the city of Yuma to a point east of Wellton. This area is mapped as Torriorthents-Torrifluvents complex, 1 to 50 percent slopes. The escarpment between the mesas and the Gila River flood plain extends to the survey area boundary.

The ancient geomorphic surfaces that formed during periods of higher rainfall, cooler climate, and more dense plant cover are extensive as alluvial fan piedmonts. These surfaces occur as dissected fans and ridges that extend from the Gila-Mohawk Mountain and the Hyder area. The soils commonly have "desert pavement," which is a surficial lag concentrate, and are considered to be the oldest soils in the area. These soils are in the Ligurta-Cristobal complex and are Typic Haplargids. These soils have an argillic horizon and an electrical conductivity of 40 to 50 millimhos in the upper 10 inches of the surface layer, and they have a thin A horizon. The Harqua soils, which are Typic Haplargids, are also in the Hyder area. They are similar to the soils of the Ligurta-Cristobal complex in that they have a salic horizon.

Laposa soils formed in material derived from granite, gneiss, and schist on mountains. Geologic erosion of this material has formed alluvial fans of Holocene age. Carrizo soils formed on the fans, which extend from the mountains and coalesce with the mesas and flood plains.

The eastern part of the survey area borders the Sentinel Plains area and consists of relatively recent volcanic rock. On the upper slopes are Cherioni soils, Typic Durorthids, which are characterized by a duripan that lies over bedrock. Gachado soils, Lithic Haplargids, are on the lower slopes. These soils are shallow and have an argillic horizon over bedrock. Most of the soils in the valley consist of nine soils that formed in flood plain alluvium. Gadsden, Glenbar, Indio, Ripley, Holtville, Kofa, Vint, Gilman, and Lagunita soils formed in flood plain sediment of variable texture.

References

(1) American Association of State Highway (and Transportation) Officials. 1970. Standard specifications for highway materials and methods of sampling and testing. Ed. 10, 2 vol., illus.

(2) American Society for Testing and Materials. 1974. Method for classification of soils for engineering purposes. ASTM Stand. D. 2487-69. *In* 1974 Annual Book of ASTM Standards, Part 19, 464 pp., illus.

(3) Broecker, W. S. 1966. Absolute dating and the astronomical theory of glaciation science. Vol. 151, pp. 199-304.

(4) Loeltz, O. J. and C. C. McDonald. 1969. Water loss in the lower Colorado River Valley, Davis Dam to Imperial Dam. Am. Soc. Civil Engineers, Vol. 95, No. IR1, proc. paper 6457, pp. 65-78.

(5) Metzger, D. G., O. J. Loeltz, and Burdge Irelan. 1973. Geohydrology of the Parker-Blythe-Cibola area, Arizona and California. U.S. Geol. Survey Prof. Paper 486-G, 130 pp., illus.

(6) Olmsted, F. H., O. J. Loeltz, and Burdge Irelan. 1973. Geohydrology of the Yuma area, Arizona and California. U.S. Geol. Survey Prof. Paper 486-H, 227 pp., illus.

(7) Olmsted, F. H. 1972. Geology of the Laguna Dam 7-1/2 minute quadrangle, Arizona and California, U.S. Geol. Survey, Geol. Quad. Map GQ-1014, Scale: 1:24,000.

(8) Sykes, G. G. 1914. Geographical features of the Cahuilla Basin. *In* MacDougal, D. T., and others. The Salton Sea, Carnegie Inst., Washington Pub. 193, pp. 13-20.

(9) Sykes, G. G. 1931. The Colorado Delta. Carnegie Inst., Washington and Am. Geog. Soc. N.Y. Pub. No. 460, pp. 193.

(10) United States Department of Agriculture. 1951. Soil survey manual. U.S. Dep. Agric. Handb. 18, 503 pp., illus. (Supplements replacing pp. 173-188 issued May 1962).

(11) United States Department of Agriculture. 1954. Diagnosis and improvement of saline and alkali soils. U. S. Dep. Agric. Handb. 60, 160 pp., illus.

(12) United States Department of Agriculture. 1975. Soil taxonomy: a basic system of soil classification for making and interpreting soil surveys. U.S. Dep. Agric. Hand. 436, 754 pp., illus.

(13) Veeh, H. H. 1966. Th 230/U 238 and U 234/U 238 ages of Pleistocene high sea level stand. Jour. Geophys. Research, Vol. 71, No. 14, pp. 3379-3386.

Glossary

Aggregate, soil. Many fine particles held in a single mass or cluster. Natural soil aggregates, such as granules, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

Area reclaim. An area difficult to reclaim after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.

Available water capacity (available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as—

	Inches
Very low	0 to 3
Low	3 to 6
Moderate	6 to 9
High	More than 9

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Calcareous soil. A soil containing enough calcium carbonate (commonly with magnesium carbonate) to effervesce (fizz) visibly when treated with cold, dilute hydrochloric acid. A soil having measurable amounts of calcium carbonate or magnesium carbonate.

Caliche. A more or less cemented deposit of calcium carbonate in soils of warm-temperate, subhumid to arid areas. Caliche occurs as soft, thin layers in the soil or as hard, thick beds just beneath the solum, or it is exposed at the surface by erosion.

Capillary water. Water held as a film around soil particles and in tiny spaces between particles. Surface tension is the adhesive force that holds capillary water in the soil.

Cation-exchange capacity. The total amount of exchangeable cations that can be held by the soil, expressed in terms of milliequivalents per 100 grams of soil at neutrality (pH 7.0) or at some other stated pH value. The term, as applied to soils, is synonymous with base-exchange capacity, but is more precise in meaning.

Chiseling. Tillage with an implement having one or more soil-penetrating points that loosen the subsoil and bring clods to the surface. A form of emergency tillage to control soil blowing.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coat, clay skin.

Coarse fragments. Mineral or rock particles up to 3 inches (2 millimeters to 7.5 centimeters) in diameter.

Coarse textured (light textured) soil. Sand or loamy sand.

Colluvium. Soil material or rock fragments, or both, moved by creep, slide, or local wash and deposited at the base of steep slopes.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrated compounds or cemented soil grains. The composition of most concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are common compounds in concretions.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard; little affected by moistening.

Control section. The part of the soil on which classification is based. The thickness varies among different kinds of soil, but for many it is 40 or 80 inches (1 or 2 meters).

Corrosive. High risk of corrosion to uncoated steel or deterioration of concrete.

Cover crop. A close-growing crop grown primarily to improve and protect the soil between periods of regular crop production, or a crop grown between trees and vines in orchards and vineyards.

Cutbanks cave. Unstable walls of cuts made by earthmoving equipment. The soil sloughs easily.

Delta. An alluvial deposit, commonly triangular in shape, formed largely beneath water and deposited at the mouth of a river or stream.

Depth to rock. Bedrock at a depth that adversely affects the specified use.

Drainage class (natural). Refers to the frequency and duration of periods of saturation or partial saturation during soil formation, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven classes of natural soil drainage are recognized:

Excessively drained.—Water is removed from the soil very rapidly. Excessively drained soils are commonly very coarse textured, rocky, or shallow. Some are steep. All are free of the mottling related to wetness.

Somewhat excessively drained.—Water is removed from the soil rapidly. Many somewhat excessively drained soils are sandy and rapidly pervious. Some are shallow. Some are so steep that much of the water they receive is lost as runoff. All are free of the mottling related to wetness.

Well drained.—Water is removed from the soil readily, but not rapidly. It is available to plants throughout most of the growing season, and wetness does not inhibit growth of roots for significant periods during most growing seasons. Well drained soils are commonly medium textured. They are mainly free of mottling.

Moderately well drained.—Water is removed from the soil somewhat slowly during some periods. Moderately well drained soils are wet for only a short time during the growing season, but periodically for long enough that most mesophytic crops are affected. They commonly have a slowly pervious layer within or directly below the solum, or periodically receive high rainfall, or both.

Somewhat poorly drained.—Water is removed slowly enough that the soil is wet for significant periods during the growing season. Wetness markedly restricts the growth of mesophytic crops unless artificial drainage is provided. Somewhat poorly drained soils commonly have a slowly pervious layer, a high water table, additional water from seepage, nearly continuous rainfall, or a combination of these.

Poorly drained.—Water is removed so slowly that the soil is saturated periodically during the growing season or remains wet for long periods. Free water is commonly at or near the surface for long enough during the growing season that most mesophytic crops cannot be grown unless the soil is artificially drained. The soil is not continuously saturated in layers directly below plow depth. Poor drainage results from a high water table, a slowly pervious layer within the profile, seepage, nearly continuous rainfall, or a combination of these.

Very poorly drained.—Water is removed from the soil so slowly that free water remains at or on the surface during most of the growing season. Unless the soil is artificially drained, most mesophytic crops cannot be grown. Very poorly drained soils are commonly level or depressed and are frequently ponded. Yet, where rainfall is high and nearly continuous, they can have moderate or high slope gradients, as for example in "hillpeats" and "climatic moors."

Drainage, surface. Runoff, or surface flow of water, from an area.

Eluviation. The movement of material in true solution or colloidal suspension from one place to another within the soil. Soil horizons that have lost material through eluviation are eluvial; those that have received material are illuvial.

Erosion. The wearing away of the land surface by running water, wind, ice, or other geologic agents and by such processes as gravitational creep.

Erosion (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.

Erosion (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of the activities of man or other animals or of a catastrophe in nature, for example, fire, that exposes a bare surface.

Excess fines. Excess silt and clay. The soil does not provide a source of gravel or sand for construction purposes.

Excess salts. Excess water soluble salts. Excessive salts restrict the growth of most plants.

Fast intake. The rapid movement of water into the soil.

Fine textured (heavy textured) soil. Sandy clay, silty clay, and clay.

Flooding. The temporary covering of soil with water from overflowing streams, runoff from adjacent slopes, and tides. Frequency, duration, and probable dates of occurrence are estimated. Frequency is expressed as none, rare, occasional, and frequent. *None* means that flooding is not probable; *rare* that it is unlikely but possible under unusual weather conditions; *occasional* that it occurs on an average of once or less in 2 years; and *frequent* that it occurs on an average of more than once in 2 years. Duration is expressed as *very brief* if less than 2 days, *brief* if 2 to 7 days, and *long* if more than 7 days. Probable dates are expressed in months; *November-May*, for example, means that flooding can occur during the period November through May. Water standing for short periods after rainfall or commonly covering swamps and marshes is not considered flooding.

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Foot slope. The inclined surface at the base of a hill.

Infiltration rate. The rate at which water penetrates the surface of the soil at any given instant, usually expressed in inches per hour. The rate can be limited by the infiltration capacity of the soil or the rate at which water is applied at the surface.

Irrigation. Application of water to soils to assist in production of crops. Methods of irrigation are—

Border.—Water is applied at the upper end of a strip in which the lateral flow of water is controlled by small earth ridges called border dikes, or borders.

Basin.—Water is applied rapidly to nearly level plains surrounded by levees or dikes.

Furrow.—Water is applied in small ditches made by cultivation implements. Furrows are used for tree and row crops.

Sprinkler.—Water is sprayed over the soil surface through pipes or nozzles from a pressure system.

Leaching. The removal of soluble material from soil or other material by percolating water.

Loam. Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

Low strength. Inadequate strength for supporting loads.

Metamorphic rock. Rock of any origin altered in mineralogical composition, chemical composition, or structure by heat, pressure, and movement. Nearly all such rocks are crystalline.

Minimum tillage. Only the tillage essential to crop production and prevention of soil damage.

Moderately coarse textured (moderately light textured) soil. Sandy loam and fine sandy loam.

Moderately fine textured (moderately heavy textured) soil. Clay loam, sandy clay loam, and silty clay loam.

Morphology, soil. The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.

Mottling, soil. Irregular spots of different colors that vary in number and size. Mottling generally indicates poor aeration and impeded drainage. Descriptive terms

are as follows: abundance—*few, common,* and *many*; size—*fine, medium,* and *coarse*; and contrast—*faint, distinct,* and *prominent*. The size measurements are of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium*, from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse*, more than 15 millimeters (about 0.6 inch).

Munsell notation. A designation of color by degrees of the three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color of 10YR hue, value of 6, and chroma of 4.

Pan. A compact, dense layer in a soil. A pan impedes the movement of water and the growth of roots. The word "pan" is commonly combined with other words that more explicitly indicate the nature of the layer; for example, *hardpan, fragipan, claypan, plowpan,* and *traffic pan*.

Parent material. The great variety of unconsolidated organic and mineral material in which soil forms. Consolidated bedrock is not yet parent material by this concept.

Pedon. The smallest volume that can be called "a soil." A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

Percs slowly. The slow movement of water through the soil adversely affecting the specified use.

pH value. (See Reaction, soil). A numerical designation of acidity and alkalinity in soil.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Reaction, soil. The degree of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degree of acidity or alkalinity is expressed as—

	pH
Extremely acid	Below 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Medium acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Mildly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Relief. The elevations or inequalities of a land surface, considered collectively.

Residuum (residual soil material). Unconsolidated, weathered, or partly weathered mineral material that accumulates over disintegrating rock.

Rock fragments. Rock or mineral fragments having a diameter of 2 millimeters or more; for example, pebbles, cobbles, stones, and boulders.

Runoff. The precipitation discharged in stream channels from a drainage area. The water that flows off the land surface without sinking in is called surface runoff; that which enters the ground before reaching surface streams is called ground-water runoff or seepage flow from ground water.

Saline soil. A soil containing soluble salts in an amount that impairs growth of plants. A saline soil does not contain excess exchangeable sodium.

Sedimentary rock. Rock made up of particles deposited from suspension in water. The chief kinds of sedimentary rock are conglomerate, formed from gravel; sandstone, formed from sand; shale, formed from clay; and limestone, formed from soft masses of calcium carbonate. There are many intermediate types. Some wind-deposited sand is consolidated into sandstone.

Seepage. The rapid movement of water through the soil. Seepage adversely affects the specified use.

Series, soil. A group of soils, formed from a particular type of parent material, having horizons that, except for the texture of the A horizon, or surface layer, are similar in all profile characteristics and in arrangement in the soil profile. Among these characteristics are color, texture, structure, reaction, consistence, and mineralogical and chemical composition.

Shrink-swell. The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

Silica. A combination of silicon and oxygen. The mineral form is called quartz.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Slickensides. Polished and grooved surfaces produced by one mass sliding past another. In soils, slickensides may occur at the base of slip surfaces on the steeper slopes; on faces of blocks, prisms, and columns; and in swelling clayey soils, where there is marked change in moisture content.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance.

Small stones. Rock fragments 3 to 10 inches (7.5 to 25 centimeters) in diameter. Small stones adversely affect the specified use.

Soil. A natural, three-dimensional body at the earth's surface that is capable of supporting plants and has properties resulting from the integrating effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in mature soil consists of the A and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and other plant and animal life characteristics of the soil are largely confined to the solum.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates that are separated from adjoining aggregates. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are either *single grained* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Substratum. The part of the soil below the solum.

Subsurface layer. Technically, the A2 horizon. Generally refers to a leached horizon lighter in color and lower in content of organic matter than the overlying surface layer.

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea. A stream terrace is frequently called a second bottom, in contrast with a flood plain, and is seldom subject to overflow. A marine terrace, generally wide, was deposited by the sea.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt, silt loam, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Thin layer. Otherwise suitable soil material too thin for the specified use.

Toe slope. The outermost inclined surface at the base of a hill; part of a foot slope.

Topsoil (engineering). Presumably a fertile soil or soil material, or one that responds to fertilization, ordinarily rich in organic matter, used to topdress roadbanks, lawns, and gardens.

Upland (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

Water table. The upper limit of the soil or underlying rock material that is wholly saturated with water.

Water table, apparent. A thick zone of free water in the soil. An apparent water table is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil.

Water table, artesian. A water table under hydrostatic head, generally beneath an impermeable layer. When this layer is penetrated, the water level rises in an uncased borehole.

Water table, perched. A water table standing above an unsaturated zone. In places an upper, or perched, water table is separated from a lower one by a dry zone.

ILLUSTRATIONS

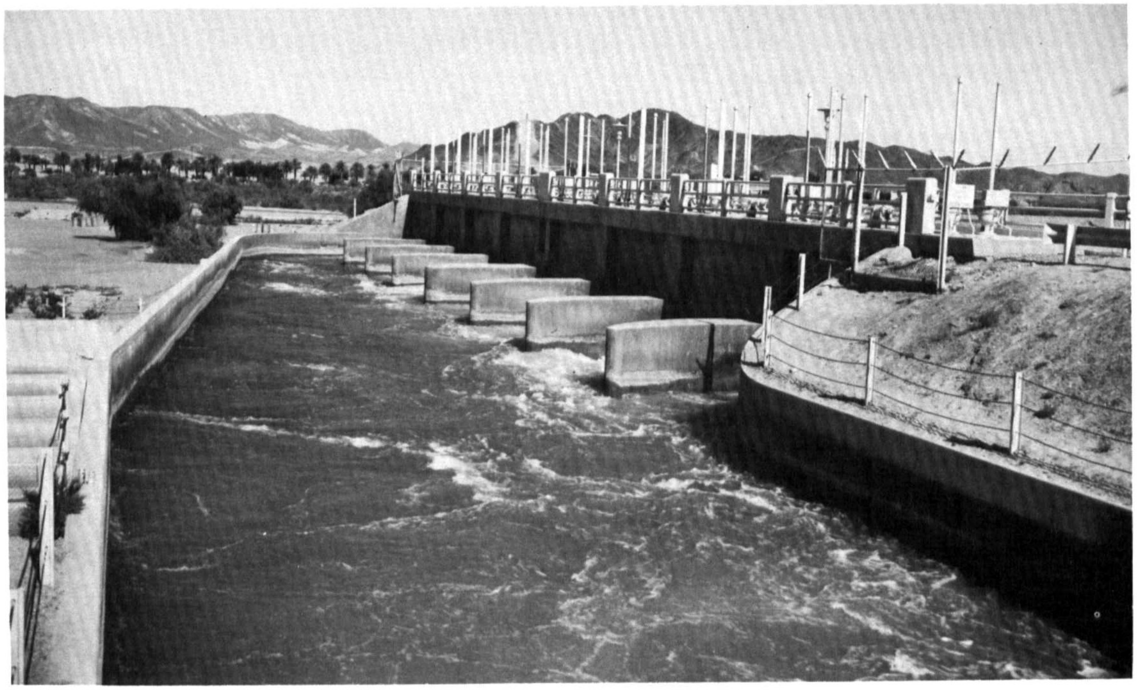


Figure 1.—Imperial Dam on Colorado River. Turnouts lead to canals that deliver water to the Wellton-Mohawk Irrigation District.

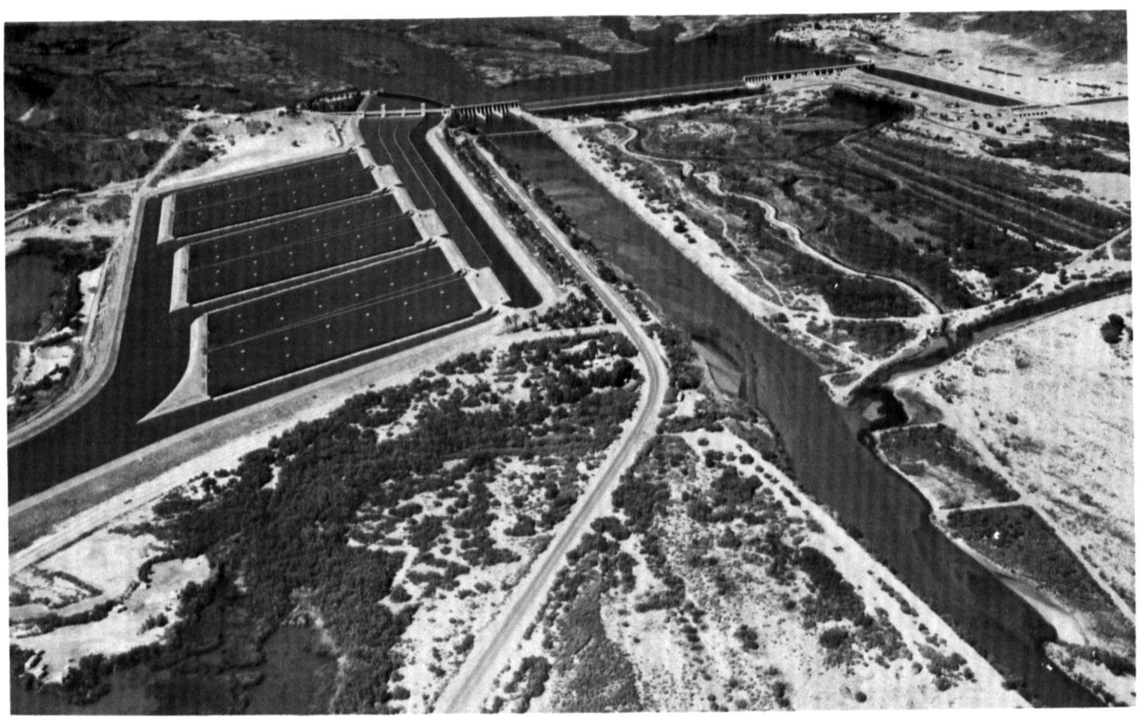


Figure 2.—Imperial Dam and diversion on the Colorado River. Desilting basins are at left. Turnouts and delivery canals for Bard area, California, in center and for Wellton-Mohawk Valley, Arizona, at far right.

Figure 3.—Young citrus trees on Gadsden clay. Wind machines in background are used to protect the trees from frost on cold nights.

Figure 4.—Grain sorghum on Indio silt loam. This soil can produce 100 bushels per acre.

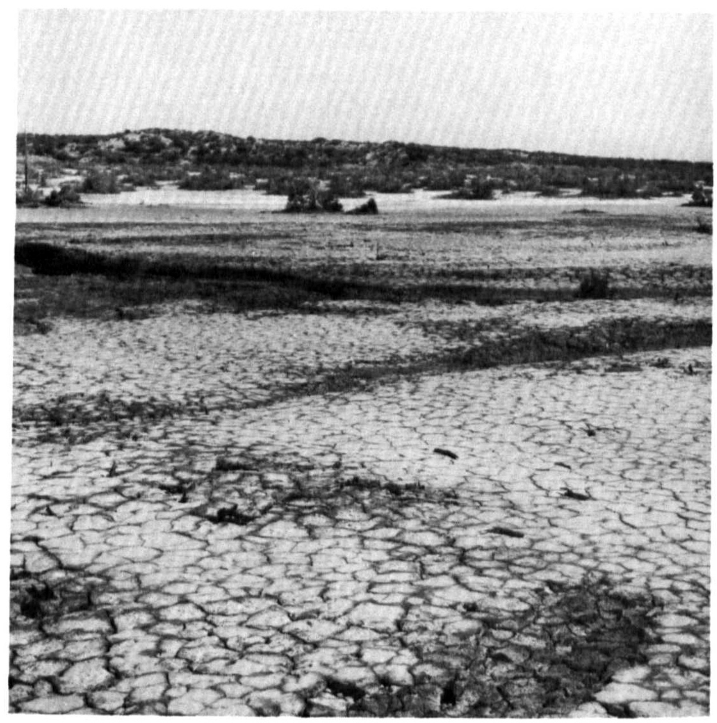


Figure 5.—Area of Indio silt loam, strongly saline. Accumulations of salt and dessication cracks are at surface.

Figure 6.—Dual cropping of young citrus trees and wheat on Kofa clay. This soil can produce 90 bushels of wheat per acre.

Figure 7.—Alfalfa, one of the most important crops in the survey area, on Kofa clay. Yields of 8 tons of hay per acre are common.

Figure 8.—Small grain on a Lagunita loamy sand provides food for wildlife. Colorado River in background.

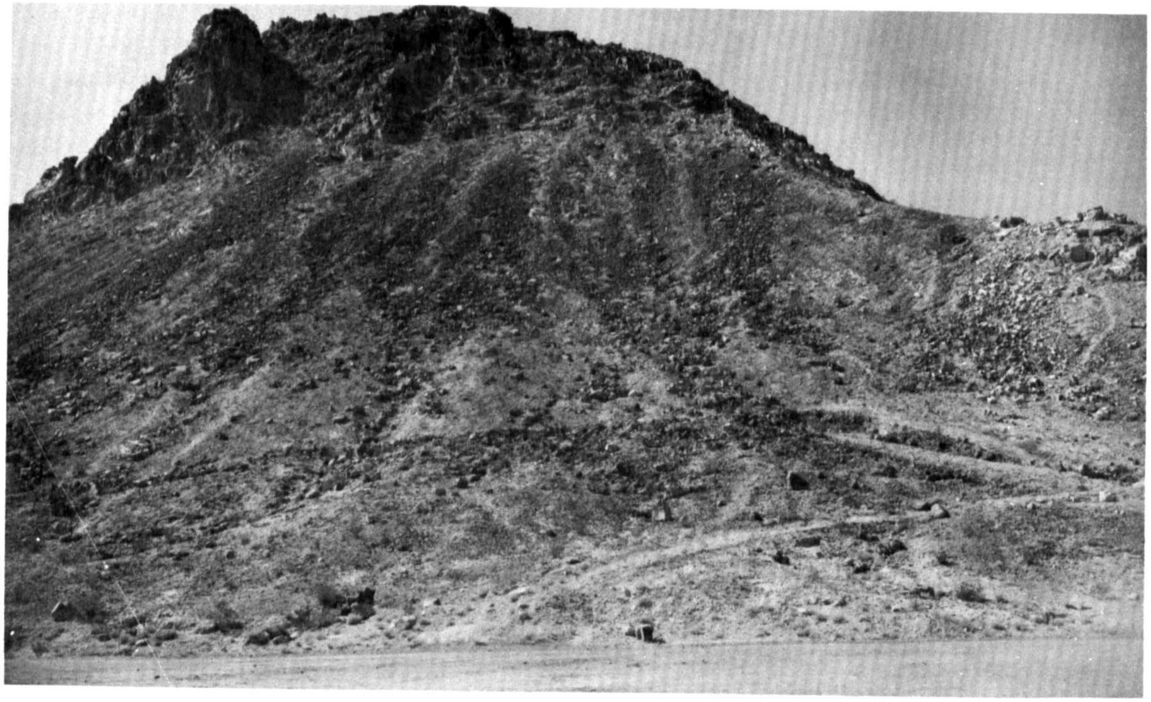


Figure 9.—Area of Laposa-Rock outcrop complex, 15 to 75 percent slopes, in Granitic Hills range site.

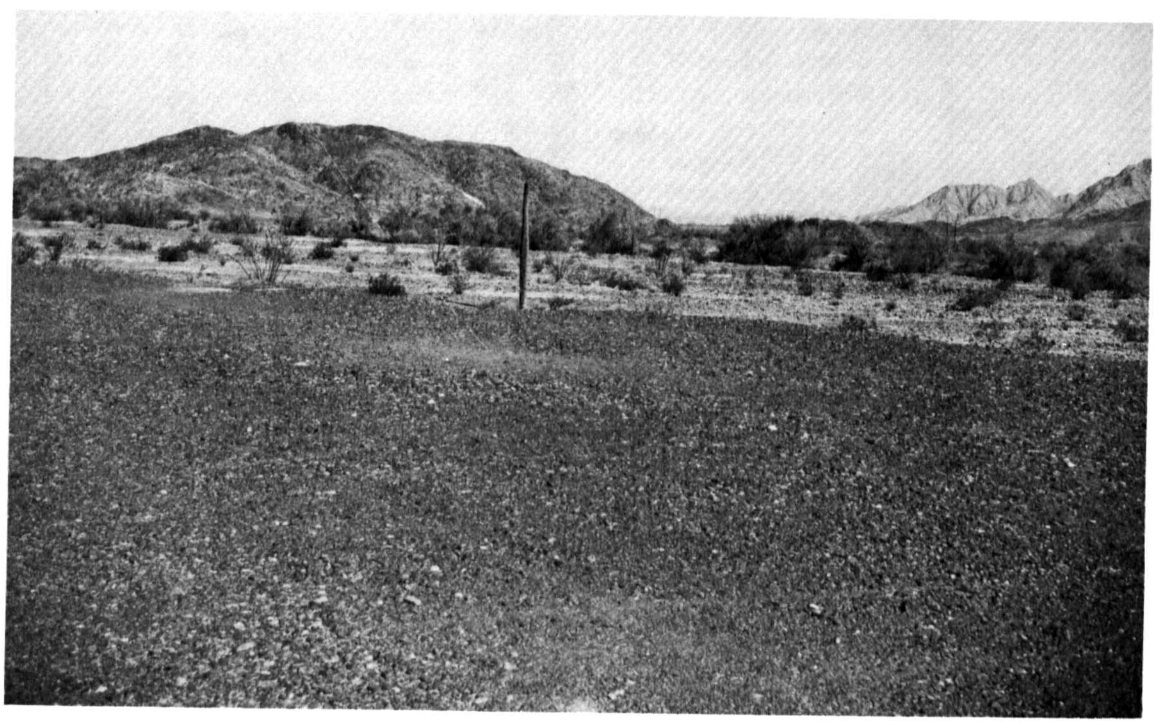


Figure 10.—Area of Ligurta-Cristobal complex, 2 to 6 percent slopes, in Saline Terrace range site. This complex typically is covered with desert pavement. Area of Laposa-Rock outcrop complex in background and of Carrizo soils in draws.

Figure 11.—Area of Rositas sand in Deep Sand range site. Dominant plant is big galleta.

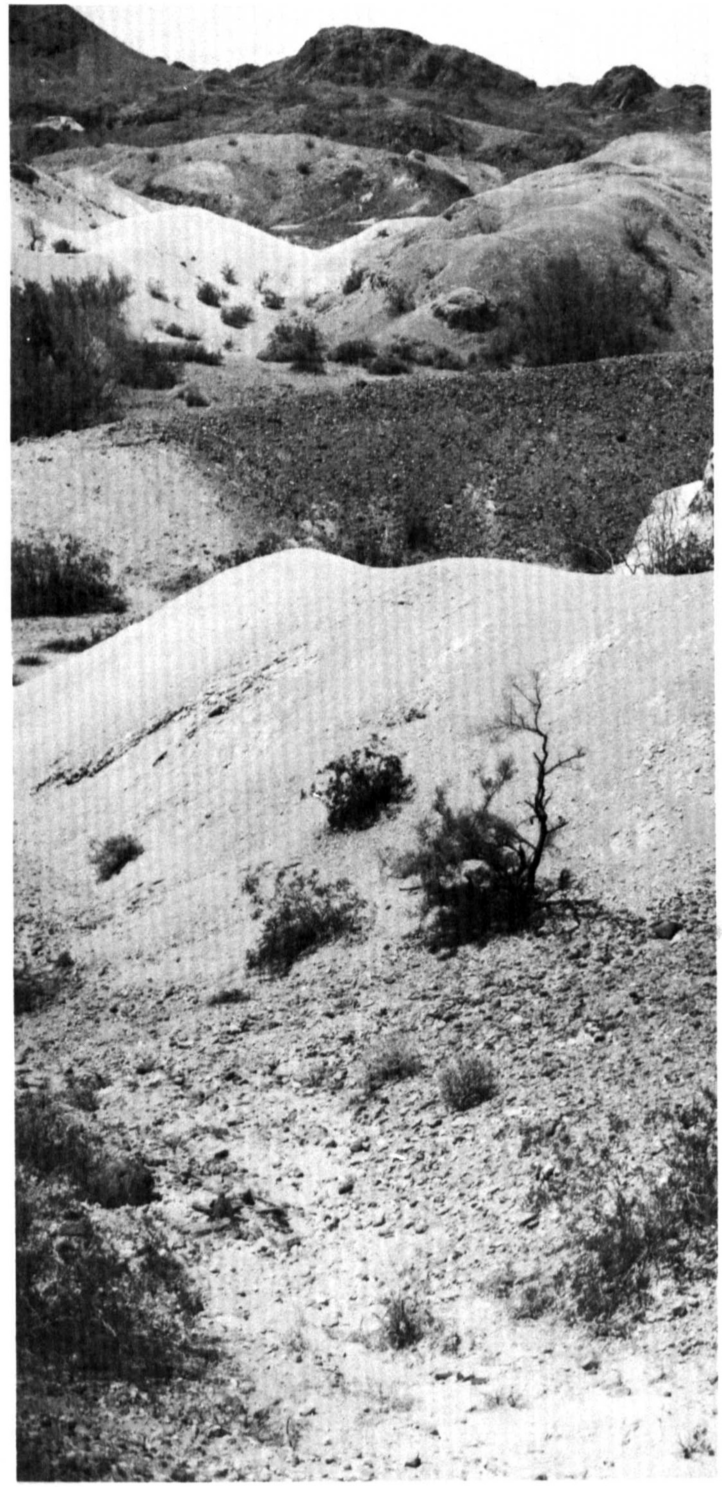


Figure 12.—Area of Torriorthents-Torrifluvents complex, 1 to 50 percent slopes.

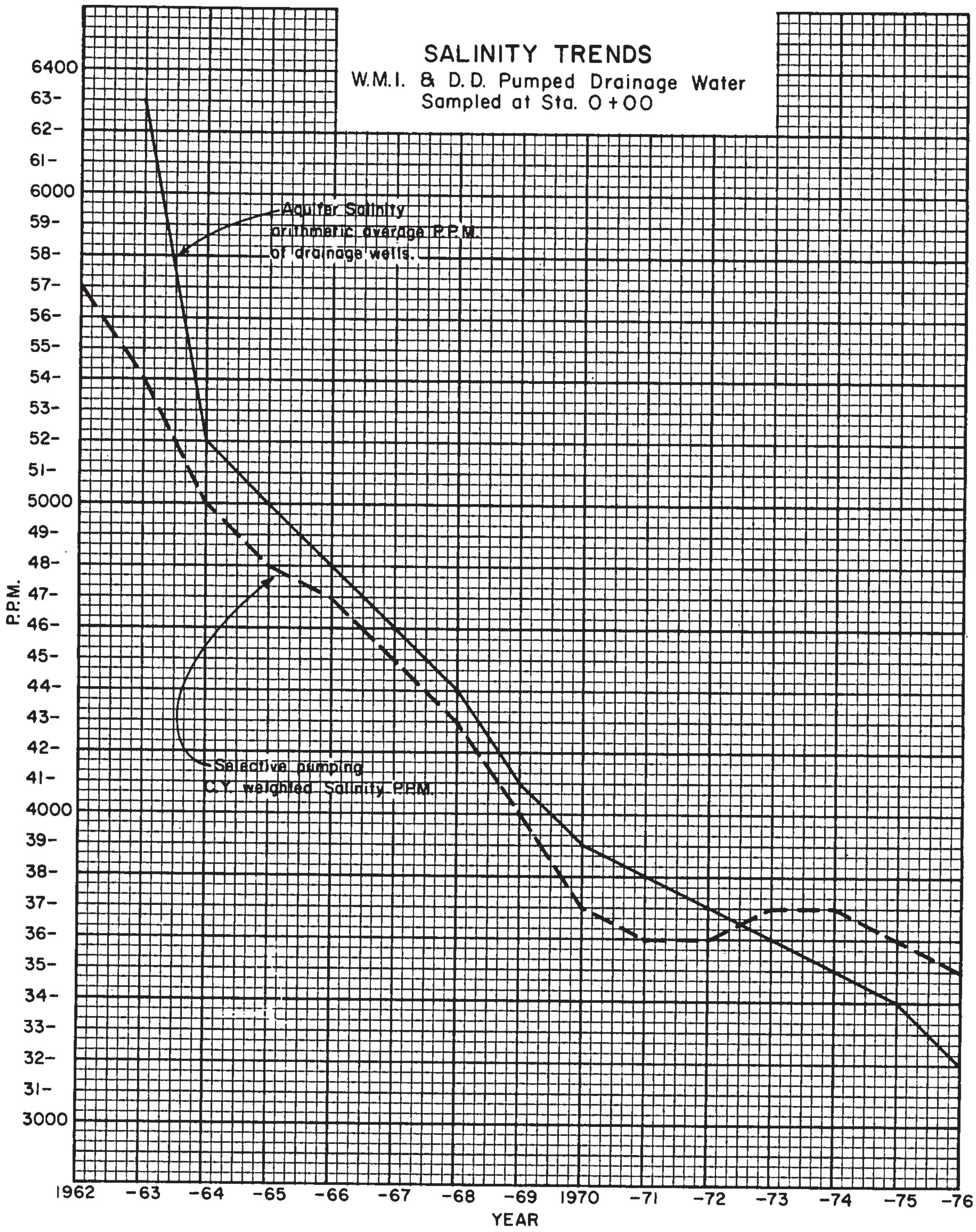


Figure 13.—Salinity trends.

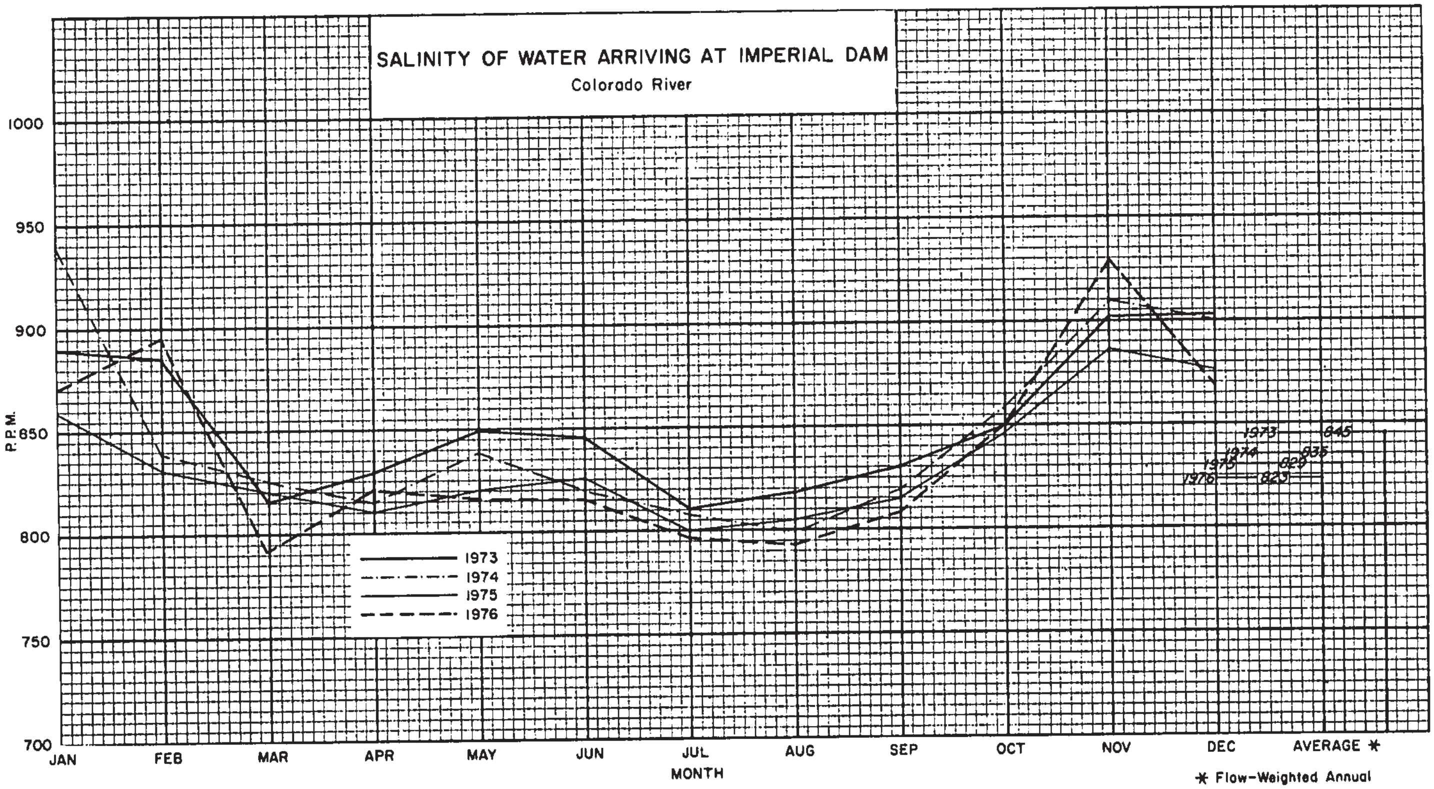


Figure 14.—Salinity of water arriving at Imperial Dam.

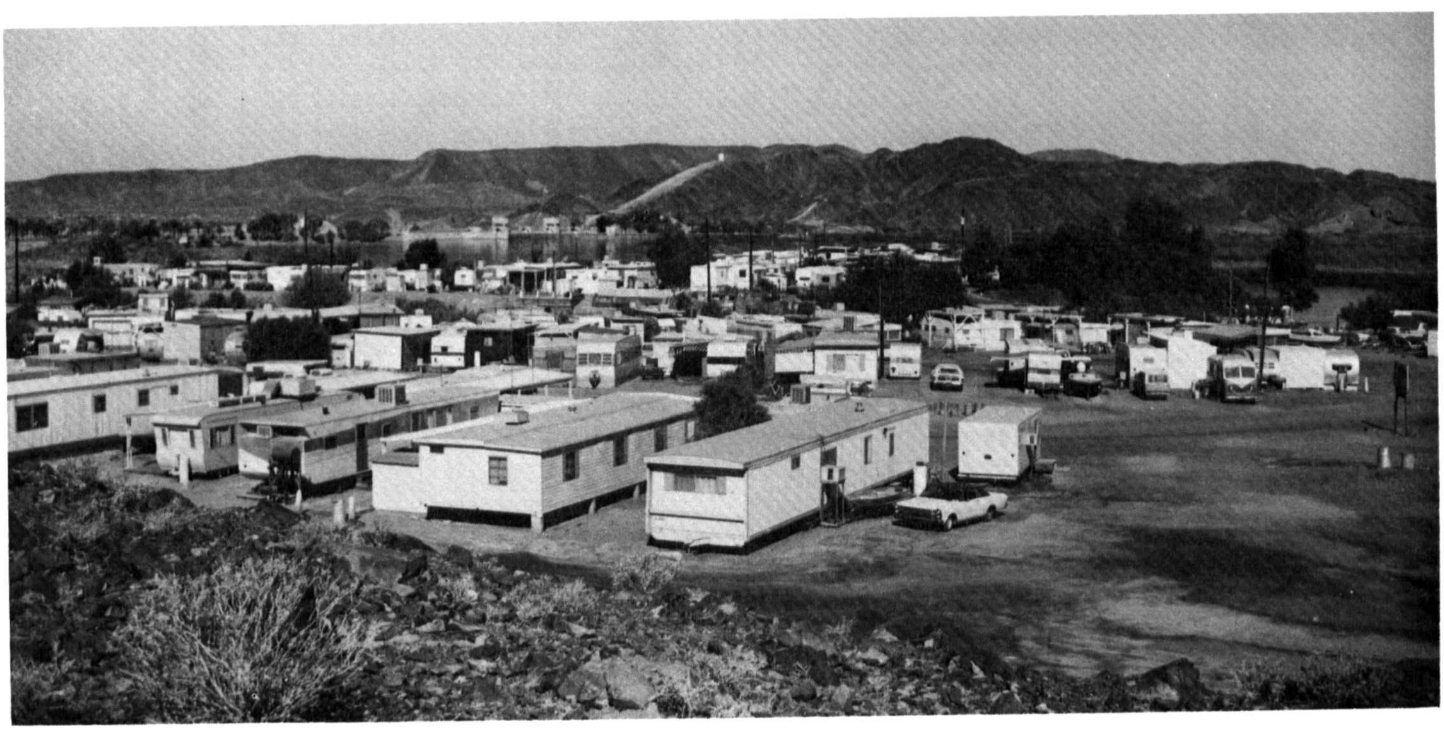


Figure 15.—Campers along Colorado River, a common sight each winter.

TABLES

TABLE 1.--TEMPERATURE AND PRECIPITATION

Month	Temperature[1]						Precipitation[1]				
	Average daily maximum	Average daily minimum	Average daily	2 years in 10 will have-- Maximum temperature higher than--	2 years in 10 will have-- Minimum temperature lower than--	Average number of growing degree days[2]	Average	2 years in 10 will have-- Less than--	2 years in 10 will have-- More than--	Average number of days with 0.10 inch or more	Average snowfall
	°F	°F	°F	°F	°F	Units	In	In	In		In
January----	69.0	37.5	53.3	83	23	144	.24	---	.41	1	.0
February---	74.0	40.4	57.2	89	28	218	.16	---	.27	1	.0
March------	78.5	44.7	61.6	95	30	365	.20	---	.34	1	.0
April------	85.3	50.6	68.0	102	37	540	.12	---	.17	0	.0
May--------	93.6	57.4	75.5	110	44	791	.01	---	---	0	.0
June-------	101.4	64.4	82.9	115	53	987	.01	---	---	0	.0
July-------	106.3	74.2	90.2	114	61	1,246	.07	---	.12	1	.0
August-----	105.1	74.2	89.7	114	62	1,231	.18	---	.31	1	.0
September--	101.2	66.7	84.0	112	51	1,020	.31	---	.34	0	.0
October----	91.2	55.5	73.4	105	41	725	.27	---	.32	1	.0
November---	78.2	45.3	61.8	93	31	354	.27	---	.44	1	.0
December---	68.9	38.6	53.8	82	26	141	.45	---	.76	1	.0
Yearly:											
Average--	87.7	54.1	71.0	---	---	---	---	---	---	---	---
Extreme--	---	---	---	115	23	---	---	---	---	---	---
Total----	---	---	---	---	---	7,762	2.29	1.01	3.31	8	.0

[1]Data were recorded in the period 1951-75 in Yuma Valley, Ariz.

[2]A growing degree day is a unit of heat available for plant growth. It can be calculated by adding the maximum and minimum daily temperatures, dividing the sum by 2, and subtracting the temperature below which growth is minimal for the principal crops in the area (50° F).

TABLE 2.--FREEZE DATES IN SPRING AND FALL

Probability	Minimum temperature[1]		
	24 F or lower	28 F or lower	32 F or lower
Last freezing temperature in spring:			
1 year in 10 later than--	January 14	February 26	March 13
2 years in 10 later than--	January 08	February 11	March 03
5 years in 10 later than--	(2)	January 10	February 11
First freezing temperature in fall:			
1 year in 10 earlier than--	January 11	December 02	November 16
2 years in 10 earlier than--	January 14	December 10	November 25
5 years in 10 earlier than--	(2)	December 27	December 11

[1]Data were recorded in the period 1951-75 at Yuma Valley, Ariz.
[2]Probability of occurrence of threshold temperature is less than indicated probability.

TABLE 3.--GROWING SEASON LENGTH[1]

Probability	Daily minimum temperature during growing season		
	Higher than 24 F	Higher than 28 F	Higher than 32 F
	Days	Days	Days
9 years in 10	>365	293	259
8 years in 10	>365	308	274
5 years in 10	>365	>365	303
2 years in 10	>365	>365	331
1 year in 10	>365	>365	346

[1]Data were recorded in the period 1951-75 at Yuma Valley, Ariz.

TABLE 4.--NUMBER OF COLD NIGHTS[1]

Season	Month								
	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	Total
1964-65	---	9	15	14	12	4	0	0	54
1965-66	0	1	11	23	21	4	0	0	60
1966-67	0	6	21	24	16	4	0	1	72
1967-68	0	0	20	25	2	4	0	0	51
1968-69	0	3	27	13	14	12	0	0	69
1969-70	1	6	14	17	6	4	4	0	52
1970-71	3	10	23	24	16	13	0	0	89
1971-72	3	14	21	30	15	2	0	0	85
1972-73	0	12	23	25	6	0	1	0	67
1973-74	0	8	22	16	24	3	0	0	73
1974-75	0	7	27	25	15	1	---	---	75

[1]A cold night is defined as one on which the minimum temperature fell to 32 degrees F, or lower, at one or more stations.

TABLE 5.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

Map symbol	Soil name	Yuma County, Arizona	Imperial County, California	Total-- Area	Total-- Extent
		Acres	Acres	Acres	Pct
1	Antho sandy loam	16,990	0	16,990	1.6
2	Antho fine sandy loam	4,105	0	4,105	0.4
3	Carrizo very gravelly sand	43,177	0	43,177	4.0
4	Cherioni-Rock outcrop complex, 25 to 70 percent slopes	16,845	0	16,845	1.6
5	Dateland loamy fine sand	12,491	0	12,491	1.2
6	Dateland fine sandy loam	7,037	0	7,037	0.7
7	Gachado very gravelly loam	8,496	0	8,496	0.8
8	Gadsden clay	21,326	2,554	23,880	2.2
9	Gilman loam	1,213	0	1,213	0.1
10	Glenbar silty clay loam	14,938	0	14,938	1.4
11	Harqua-Tremant complex	115,695	0	115,695	11.5
12	Holtville clay	25,060	4,260	29,320	2.7
13	Indio silt loam	76,051	5,793	81,844	7.7
14	Indio silt loam, saline	10,149	133	10,282	1.0
15	Indio silt loam, strongly saline	5,722	1,051	6,773	0.6
16	Indio-Lagunita-Ripley complex	54,577	2,073	56,650	5.3
17	Kofa clay	9,016	4,646	13,662	1.3
18	Lagunita loamy sand	10,551	262	10,813	1.0
19	Lagunita silt loam	2,228	434	2,662	0.2
20	Laposa-Rock outcrop complex, 15 to 75 percent slopes	101,914	198	102,112	10.2
21	Ligurta-Cristobal complex, 2 to 6 percent slopes	201,384	0	201,384	20.1
22	Pits, borrow	1,079	0	1,079	0.1
23	Pits, gravel	149	0	149	*
24	Ripley silt loam	14,285	2,305	16,590	1.6
25	Rositas sand	53,135	137	53,272	5.0
26	Rositas-Ligurta complex	18,244	0	18,244	1.7
27	Salorthids, nearly level	2,434	0	2,434	0.2
28	Superstition sand	42,440	0	42,440	4.0
29	Superstition complex	2,433	0	2,433	0.2
30	Torriorthents-Torrifluvents complex, 1 to 50 percent slopes	26,717	849	27,566	2.6
31	Tremant-Rositas complex	52,581	0	52,581	4.9
32	Vint loamy fine sand	5,714	0	5,714	0.5
33	Wellton loamy sand	16,542	0	16,542	1.5
34	Wellton-Dateland-Rositas complex	7,802	0	7,802	0.7
	Water area	15,092	122	15,214	1.4
	Total	1,017,612	24,817	1,042,429	100.0

* Less than 0.1 percent.

TABLE 6.--YIELDS PER ACRE OF IRRIGATED CROPS

[Yields are those that can be expected under a high level of management. The estimates were made in 1977. Absence of a yield indicates that the soil is not suited to the crop or the crop generally is not grown on the soil. Soils not listed generally are not suited to irrigated crops]

Soil name and map symbol	Alfalfa hay	Cotton lint	Wheat	Grain sorghum	Lemons	Lettuce
	Ton	Lb	Bu	Bu	Box	Crate
1, 2 Antho	8.5	1,500	---	90	---	---
5, 6 Dateland	9.0	1,000	60	---	350	---
8* Gadsden	9.0	1,900	105	120	---	---
9 Gilman	9.0	1,600	---	110	---	---
10 Glenbar	9.0	1,800	---	125	---	---
12 Holtville	7	1,200	---	---	---	250
13 Indio	9	1,400	110	100	---	190
14 Indio	9	1,250	110	100	---	190
16:						
Indio part	9	1,267	---	---	---	---
Lagunita part	7	1,000	---	70	---	---
Ripley part	9	1,600	90	100	---	184
17* Kofa	8	1,900	90	90	---	185
18 Lagunita	7	1,000	---	60	---	---
19 Lagunita	8	1,200	---	70	---	---
24 Ripley	9	1,600	90	100	---	184
28 Superstition	7	1,000	60	---	350	---
29 Superstition	6	990	60	---	348	---
32 Vint	5.0	900	---	68	---	---
33 Wellton	8	1,000	---	70	---	---

* Yields are for areas protected from flooding.

TABLE 7.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES

[Only the soils that are used for rangeland are listed]

Soil name and map symbol	Range site name	Total production: Kind of year	Total production: Dry weight	Characteristic vegetation	Composition
			Lb/acre		Pct
1, 2: Antho	Sandy Loam Upland, 2 To 7 " Pz	Favorable	350	Big galleta	30
		Normal	200	White bursage	25
		Unfavorable	100	Range ratany	20
				Creosotebush	15
				Prickly pear	5
				Ocotillo	5
3: Carrizo	Sand Bottom, 2 To 7" Pz	Favorable	700	Big galleta	25
		Normal	450	Desert ironwood	20
		Unfavorable	250	Allscale saltbush	15
				Creosotebush	10
				Mesquite	10
				Littleleaf paloverde	5
				White bursage	5
4*:					
Cherioni	Basalt Hills, 2 To 7" Pz	Favorable	225	White brittlebush	70
		Normal	125	Creosotebush	20
		Unfavorable	75		
Rock outcrop.					
5, 6: Dateland	Sandy Loam Upland, 2 To 7" Pz	Favorable	200	Creosotebush	30
		Normal	125	White bursage	25
		Unfavorable	75	Range ratany	15
				Ratany	15
				Big galleta	5
7: Gachado	Basalt Hills, 2 To 7" Pz	Favorable	300	Creosotebush	15
		Normal	150	Triangle bursage	15
		Unfavorable	75	Big galleta	10
				Sandverbena	10
				Sixweeks grama	8
				White brittlebush	5
				Range ratany	5
				Threeawn	5
				Ratany	5
				Spurge	5
				Buckwheat	5
				Globemallow	5
				Other shrubs	5
11*:					
Harqua	Saline Terrace, 2 To 7" Pz	Favorable	0	Turkshead	10
		Normal	0		
		Unfavorable	0		
Tremant	Limy Upland, 2 To 7" Pz	Favorable	125	White bursage	40
		Normal	75	Creosotebush	35
		Unfavorable	25	Triangle bursage	15
				Mesquite	5
15: Indio	Saline Bottom, 2 To 7" Pz	Favorable	2,000	Saltcedar	32
		Normal	1,750	Mesquite	24
		Unfavorable	1,500	Allscale saltbush	24
				Fourwing saltbush	5
				Littleleaf paloverde	5
				Arrowweed	5
16*:					
Indio	Loamy Bottom, 2 To 7" Pz	Favorable	1,000	Saltcedar	45
		Normal	700	Mesquite	30
		Unfavorable	400	Arrowweed	20

See footnote at end of table.

TABLE 7.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site name	Total production: Kind of year	Total production: Dry weight	Characteristic vegetation	Compo- sition
			Lb/acre		Pct
16*:					
Lagunita	Sand Bottom, 2 To 7" Pz	Favorable	800	Arrowweed	45
		Normal	600	Fourwing saltbush	15
		Unfavorable	500	Desert saltbush	10
				Mesquite	10
				Fremont wolfberry	5
				Sandverbena	5
				Globemallow	5
				Other annual forbs	5
Ripley	Loamy Bottom, 2 To 7" Pz	Favorable	800	Arrowweed	60
		Normal	650	Mesquite	15
		Unfavorable	500	Other annual forbs	10
				Fourwing saltbush	5
20*:					
Laposa	Granitic Hills, 2 To 7" Pz	Favorable	125	Creosotebush	40
		Normal	50	Ocotillo	25
		Unfavorable	25	White bursage	22
				Littleleaf paloverde	5
Rock outcrop.					
21*:					
Ligurta	Saline Terrace, 2 To 7" Pz	Favorable	20	Turkshead	80
		Normal	15	Indianwheat	15
		Unfavorable	10	Creosotebush	5
Cristobal	Saline Terrace, 2 To 7" Pz	Favorable	30	Creosotebush	70
		Normal	20	Saguaro	10
		Unfavorable	10	Turkshead	7
25 Rositas	Deep Sand, 2 To 7" Pz	Favorable	800	Big galleta	30
		Normal	500	Primrose	23
		Unfavorable	200	White bursage	10
				Other annual forbs	10
				Creosotebush	8
				Fiddleneck	5
26*:					
Rositas	Deep Sand, 2 To 7" Pz	Favorable	800	Big galleta	30
		Normal	500	Primrose	23
		Unfavorable	200	White bursage	10
				Other annual forbs	10
				Creosotebush	8
				Fiddleneck	5
Ligurta	Saline Terrace, 2 To 7" Pz	Favorable	20	Turkshead	80
		Normal	15	Indianwheat	15
		Unfavorable	10	Creosotebush	5
27 Salorthids	Saline Bottom, 2 to 7" Pz	Favorable	1200	Saltcedar	40
		Normal	1000	Arrowweed	25
		Unfavorable	800	Iodinebush	20
				Big saltbush	8
				Mesquite	5
28 Superstition	Deep Sand, 2 To 7" Pz	Favorable	50	Creosotebush	80
		Normal	25	Sandverbena	7
		Unfavorable	10		
30*:					
Torriorthents	Breaks, 2 to 7" Pz	Favorable	300	Creosotebush	30
		Normal	125	Desert saltbush	20
		Unfavorable	75	Big galleta	15
				White bursage	15
				White ratany	8
				Littleleaf paloverde	5

See footnote at end of table.

TABLE 7.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site name	Total production: Kind of year	Total production: Dry weight	Characteristic vegetation	Compo-sition
			Lb/acre		Pct
30*:					
Torrifluvents	Sandy Bottom, 2 to 7" Pz	Favorable	350	Big galleta	25
		Normal	225	Creosotebush	20
		Unfavorable	125	Desert saltbush	20
				White bursage	15
				White ratany	10
				Annual forbs	10
31*:					
Tremant	Limy Upland, 2 To 7" Pz	Favorable	125	White bursage	40
		Normal	75	Creosotebush	35
		Unfavorable	25	Triangle bursage	15
				Mesquite	5
Rositas	Deep Sand, 2 To 7" Pz	Favorable	800	Big galleta	30
		Normal	500	Primrose	23
		Unfavorable	200	White bursage	10
				Other annual forbs	10
				Creosotebush	8
				Fiddleneck	5
33 Wellton	Sandy Loam, Upland, 2 To 7" Pz	Favorable	250	White bursage	40
		Normal	150	Creosotebush	15
		Unfavorable	75	Big galleta	15
				Range ratany	10
				Prickly pear	10
				Ocotillo	5
34*:					
Wellton	Sandy Loam Upland, 2 To 7" Pz	Favorable	250	White bursage	40
		Normal	150	Creosotebush	15
		Unfavorable	75	Big galleta	15
				Range ratany	10
				Prickly pear	10
				Ocotillo	5
Dateland	Sandy Loam Upland, 2 To 7" Pz	Favorable	200	Creosotebush	30
		Normal	125	White bursage	25
		Unfavorable	75	Range ratany	15
				Ratany	15
				Big galleta	5
Rositas	Deep Sand, 2 To 7" Pz	Favorable	800	Big galleta	30
		Normal	500	Primrose	23
		Unfavorable	200	White bursage	10
				Other annual forbs	10
				Creosotebush	8
				Fiddleneck	5

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 8.--RECREATIONAL DEVELOPMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
1, 2 Antho	Slight	Slight	Slight	Slight.
3 Carrizo	Severe: floods, too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.
4*:				
Cherioni	Severe: slope, small stones, depth to rock.	Severe: slope, small stones.	Severe: slope, small stones, depth to rock.	Severe: slope, small stones.
Rock outcrop.				
5, 6 Dateland	Slight	Slight	Slight	Slight.
7 Gachado	Severe: small stones, depth to rock.	Severe: small stones.	Severe: small stones, depth to rock.	Moderate: large stones.
8 Gadsden	Moderate: too clayey.	Severe: too clayey.	Severe: too clayey.	Moderate: too clayey.
9 Gilman	Moderate: dusty.	Moderate: dusty.	Moderate: dusty.	Moderate: dusty.
10 Glenbar	Slight floods.	Slight	Moderate: too clayey.	Slight.
11*:				
Harqua	Moderate: small stones, percs slowly.	Moderate: small stones, percs slowly.	Severe: small stones.	Moderate: small stones.
Tremant	Moderate: small stones.	Moderate: small stones.	Severe: small stones.	Moderate: small stones.
12 Holtville	Severe: too clayey.	Severe: too clayey.	Severe: too clayey.	Severe: too clayey.
13, 14 Indio	Moderate: dusty.	Moderate: dusty.	Moderate: dusty.	Moderate: dusty.
15 Indio	Severe: floods.	Moderate: dusty.	Moderate: dusty.	Moderate: dusty.
16*:				
Indio	Severe: floods.	Slight	Slight	Slight.
Lagunita	Severe: floods.	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.
Ripley	Moderate: dusty.	Moderate: dusty.	Moderate: dusty.	Moderate: dusty.
17 Kofa	Severe: too clayey.	Severe: too clayey.	Severe: too clayey.	Severe: too clayey.
18 Lagunita	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.

See footnote at end of table.

TABLE 8.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
19: Lagunita	Moderate: dusty.	Moderate: dusty.	Moderate: dusty.	Moderate: dusty.
20*:				
Laposa	Severe: slope, large stones.	Severe: slope, large stones.	Severe: slope, large stones.	Severe: slope, large stones.
Rock outcrop.				
21*:				
Ligurta	Severe: small stones.	Severe: small stones.	Severe: small stones.	Severe: small stones.
Cristobal	Severe: small stones.	Severe: small stones.	Severe: small stones.	Severe: small stones.
22, 23*. Pits				
24: Ripley	Moderate: dusty.	Moderate: dusty.	Moderate: dusty.	Moderate: dusty.
25: Rositas	Severe: too sandy.	Severe: too sandy.	Severe: too sandy, slope.	Severe: too sandy.
26*:				
Rositas	Severe: too sandy.	Severe: too sandy.	Severe: too sandy, slope.	Severe: too sandy.
Ligurta	Severe: small stones.	Severe: small stones.	Severe: small stones.	Severe: small stones.
27*. Salorthids				
28: Superstition	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.
29*:				
Superstition	Moderate: too clayey.	Moderate: too clayey.	Severe: too clayey.	Moderate: too clayey.
Superstition	Moderate: too clayey.	Moderate: too clayey.	Severe: too clayey.	Moderate: too clayey.
Superstition	Slight	Slight	Slight	Slight.
30*:				
Torriorthents.				
Torrifluvents.				
31*:				
Tremant	Moderate: small stones.	Moderate: small stones.	Severe: small stones.	Moderate: small stones.
Rositas	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.
32: Vint	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.
33: Wellton	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.

See footnote at end of table.

TABLE 8.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
34*:				
Wellton	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.	Moderate: too sandy.
Dateland	Slight	Slight	Slight	Slight.
Rositas	Severe: too sandy.	Severe: too sandy.	Severe: too sandy, slope.	Severe: too sandy.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 9.--WILDLIFE HABITAT POTENTIALS

[See text for definitions of "good," "fair," "poor," and "very poor." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Potential for habitat elements						Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Wetland wildlife	Rangeland wildlife
1, 2 Antho	Good	Good	Good	Good	Poor	Good	Good	Fair	---
3 Carrizo	Very poor	Very poor	Poor	Poor	Very poor	Very poor	Very poor	Very poor	Poor.
4*:									
Cherioni	Very poor	Very poor	Poor	Poor	Very poor	Very poor	---	Very poor	Poor.
Rock outcrop.									
5, 6 Dateland	Good	Good	Good	Good	Poor	Very poor	Good	Poor	---
7 Gachado	Very poor	Very poor	Poor	Poor	Very poor	Very poor	Very poor	Very poor	Poor.
8 Gadsden	Fair	Fair	Fair	Fair	Good	Good	Fair	Good	---
9 Gilman	Good	Good	Good	Good	Good	Fair	Good	Fair	---
10 Glenbar	Good	Good	Good	Good	Good	Fair	Good	Fair	---
11*:									
Harqua	Fair	Fair	Poor	Very poor	Good	Fair	Fair	Fair	---
Tremant	Good	Good	Good	Good	Poor	Good	Good	Fair	---
12 Holtville	Good	Good	Good	Good	Poor	Very poor	Good	Poor	---
13 Indio	Good	Good	Good	Good	Poor	Poor	Good	Poor	---
14 Indio	Good	Good	Very poor	Very poor	Poor	Good	Good	Fair	---
15 Indio	Very poor	Very poor	Poor	Poor	Very poor	Very poor	---	Very poor	Very poor.
16*:									
Indio	Very poor	Very poor	Poor	Poor	Very poor	Very poor	---	Very poor	Poor.
Lagunita	Very poor	Very poor	Poor	Poor	Very poor	Very poor	---	Very poor	Poor.
Ripley	Very poor	Very poor	Poor	Poor	Very poor	Very poor	---	Very poor	Poor.
17 Kofa	Fair	Fair	Fair	Good	Poor	Fair	Fair	Poor	---
18 Lagunita	Fair	Good	Good	Good	Very poor	Very poor	Good	Very poor	---
19 Lagunita	Good	Good	Good	Good	Very poor	Very poor	Good	Very poor	---
20*:									
Laposa	Very poor	Very poor	Poor	Poor	Very poor	Very poor	---	Very poor	Very poor.
Rock outcrop.									

See footnote at end of table.

TABLE 9.--WILDLIFE HABITAT POTENTIALS--Continued

Soil name and map symbol	Potential for habitat elements						Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herba- ceous plants	Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Wetland wildlife	Rangeland wildlife
21*:									
Ligurta-----------	Very poor	Very poor	Very poor	Poor	Very poor	Very poor	---	Very poor	Very poor.
Cristobal---------	Very poor	Very poor	Poor	Poor	Very poor	Very poor	---	Very poor	Very poor.
22*. Pits, borrow.									
23*. Pits, gravel.									
24----------------- Ripley	Good	Good	Good	Good	Poor	Poor	Good	Poor	---
25----------------- Rositas	Very poor	Very poor	Very poor	Very poor	Very poor	Very poor	Very poor	Very poor	Very poor.
26*:									
Rositas-----------	Very poor	Very poor	Very poor	Very poor	Very poor	Very poor	---	Very poor	Very poor.
Ligurta-----------	Very poor	Very poor	Very poor	Poor	Very poor	Very poor	---	Very poor	Very poor.
27*. Salorthids									
28----------------- Superstition	Poor	Poor	Poor	Very poor	Very poor	Very poor	Poor	Very poor	---
29*:									
Superstition------	Poor	Poor	Poor	Very poor	Very poor	Very poor	Poor	Very poor	---
Superstition------	Poor	Poor	Poor	Very poor	Very poor	Very poor	Poor	Very poor	---
Superstition------	Poor	Poor	Poor	Very poor	Very poor	Very poor	Poor	Very poor	---
30*:									
Torriorthents.									
Torrifluvents.									
31*:									
Tremant-----------	Very poor	Very poor	Poor	Poor	Poor	Very poor	Very poor	Poor	Poor.
Rositas-----------	Very poor	Very poor	Very poor	Very poor	Very poor	Very poor	Very poor	Very poor	Very poor.
32----------------- Vint	Good	Good	Good	Good	Poor	Very poor	Good	Poor	---
33----------------- Wellton	Good	Good	Good	Good	Poor	Very poor	Good	Poor	---
34*:									
Wellton-----------	Very poor	Very poor	Very poor	Poor	Poor	Very poor	---	Poor	Poor.
Dateland----------	Very poor	Very poor	Very poor	Poor	Poor	Very poor	---	Poor	Poor.
Rositas-----------	Very poor	Very poor	Very poor	Very poor	Very poor	Very poor	---	Very poor	Very poor.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 10.--BUILDING SITE DEVELOPMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
1, 2 Antho	Slight	Slight	Slight	Slight	Slight.
3 Carrizo	Severe: cutbanks cave.	Severe: floods.	Severe: floods.	Severe: floods.	Moderate: floods.
4*:					
Cherioni	Severe: slope, depth to rock, cemented pan.	Severe: slope, depth to rock, cemented pan.	Severe: slope, depth to rock, cemented pan.	Severe: slope, depth to rock, cemented pan.	Severe: slope, depth to rock, cemented pan.
Rock outcrop.					
5, 6 Dateland	Slight	Slight	Slight	Slight	Slight.
7 Gachado	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.
8 Gadsden	Moderate: too clayey.	Severe: low strength, shrink-swell.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.
9 Gilman	Slight	Moderate: low strength.	Moderate: low strength.	Moderate: low strength.	Moderate: low strength.
10 Glenbar	Slight	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Severe: low strength.
11*:					
Harqua	Slight	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength.
Tremant	Slight	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength.
12 Holtville	Moderate: too clayey.	Severe: shrink-swell, low strength.	Severe: shrink-swell.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.
13, 14 Indio	Slight	Slight	Slight	Slight	Moderate: low strength.
15 Indio	Moderate: floods.	Slight	Slight	Slight	Moderate: low strength, floods.
16*:					
Indio	Moderate: floods.	Severe: floods.	Severe: floods.	Severe: floods.	Moderate: low strength, floods.
Lagunita	Severe: cutbanks cave.	Severe: floods.	Severe: floods.	Severe: floods.	Moderate: floods.
Ripley	Severe: cutbanks cave.	Slight	Slight	Slight	Moderate: low strength.

See footnote at end of table.

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
17 Kofa	Severe: cutbanks cave.	Slight	Slight	Slight	Severe: shrink-swell, low strength.
18, 19 Lagunita	Severe: cutbanks cave.	Slight	Slight	Slight	Slight.
20*:					
Laposa	Severe: depth to rock, slope.	Severe: slope.	Severe: depth to rock, slope.	Severe: slope.	Severe: slope.
Rock outcrop.					
21*:					
Ligurta	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.
Cristobal	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.
22, 23*. Pits					
24 Ripley	Severe: cutbanks cave.	Slight	Slight	Slight	Moderate: low strength.
25 Rositas	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.
26*:					
Rositas	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.
Ligurta	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.
27*. Salorthids					
28 Superstition	Severe: cutbanks cave.	Slight	Slight	Slight	Slight.
29*:					
Superstition	Severe: cutbanks cave.	Slight	Slight	Slight	Slight.
Superstition	Severe: cutbanks cave.	Slight	Slight	Slight	Slight.
Superstition	Severe: cutbanks cave.	Slight	Slight	Slight	Slight.
30*:					
Torriorthents.					
Torrifluvents.					
31*:					
Tremant	Slight	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength.	Moderate: shrink-swell, low strength.
Rositas	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Slight.
32 Vint	Severe: cutbanks cave.	Slight	Slight	Slight	Moderate: low strength.

See footnote at end of table.

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
33----------------- Wellton	Slight------------	Slight------------	Slight------------	Slight-------------	Slight.
34*:					
Wellton-----------	Slight------------	Slight------------	Slight------------	Slight-------------	Slight.
Dateland----------	Slight------------	Slight------------	Slight------------	Slight-------------	Slight.
Rositas-----------	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 11.--SANITARY FACILITIES

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," "good," "fair," and other terms. Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
1, 2 Antho	Slight	Severe: seepage.	Slight	Slight	Good.
3 Carrizo	Moderate: floods.	Severe: floods.	Severe: too sandy.	Moderate: floods.	Poor: too sandy, small stones.
4*:					
Cherioni	Severe: depth to rock, slope, cemented pan.	Severe: slope, depth to rock, cemented pan.	Severe: slope, depth to rock, cemented pan.	Severe: slope, depth to rock.	Poor: slope, area reclaim, small stones.
Rock outcrop.					
5, 6 Dateland	Slight	Severe: seepage.	Slight	Slight	Good.
7 Gachado	Severe: depth to rock, percs slowly.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Poor: small stones, area reclaim.
8 Gadsden	Severe: percs slowly.	Slight	Severe: too clayey.	Slight	Poor: too clayey.
9 Gilman	Moderate: percs slowly.	Moderate: seepage.	Slight	Slight	Good.
10 Glenbar	Severe: percs slowly.	Slight	Moderate: too clayey.	Slight	Fair: too clayey.
11*:					
Harqua	Severe: percs slowly.	Moderate: slope.	Moderate: too clayey.	Slight	Fair: too clayey, small stones.
Tremant	Moderate: percs slowly.	Moderate: slope, seepage.	Slight	Slight	Fair: small stones.
12 Holtville	Severe: percs slowly.	Severe: seepage.	Slight	Slight	Fair: too clayey.
13 Indio	Slight	Moderate: seepage.	Slight	Slight	Good.
14 Indio	Moderate: percs slowly.	Moderate: seepage.	Slight	Slight	Good.
15 Indio	Slight	Moderate: seepage.	Severe: excess salt.	Slight	Good.
16*:					
Indio	Severe: floods.	Severe: floods.	Severe: excess salt.	Moderate: floods.	Good.
Lagunita	Severe: floods.	Severe: floods, seepage.	Severe: too sandy.	Moderate: floods.	Fair: too sandy.
Ripley	Slight	Severe: seepage.	Severe: too sandy.	Slight	Fair: thin layer.

See footnote at end of table.

TABLE 11.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
17------------------ Kofa	Slight-----------	Severe: seepage.	Severe: too sandy.	Slight-----------	Poor: too sandy.
18, 19-------------- Lagunita	Slight-----------	Severe: seepage.	Severe: too sandy.	Slight-----------	Fair: too sandy.
20*:					
Laposa-------------	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope.	Poor: slope, area reclaim, small stones.
Rock outcrop.					
21*:					
Ligurta------------	Severe: percs slowly.	Moderate: slope.	Severe: excess salt.	Slight-----------	Poor: excess salt.
Cristobal----------	Severe: percs slowly.	Moderate: slope.	Severe: excess salt.	Slight-----------	Poor: small stones, excess salt.
22, 23*. Pits					
24------------------ Ripley	Slight-----------	Severe: seepage.	Severe: too sandy.	Slight-----------	Fair: thin layer.
25------------------ Rositas	Moderate: slope.	Severe: seepage, slope.	Severe: too sandy.	Moderate: slope.	Poor: too sandy.
26*:					
Rositas------------	Moderate: slope.	Severe: seepage, slope.	Severe: too sandy.	Moderate: slope.	Poor: too sandy.
Ligurta------------	Severe: percs slowly.	Moderate: slope.	Severe: excess salt.	Slight-----------	Poor: excess salt.
27*. Salorthids					
28------------------ Superstition	Slight-----------	Severe: seepage.	Severe: too sandy.	Slight-----------	Poor: too sandy.
29*:					
Superstition-------	Slight-----------	Severe: seepage.	Severe: too sandy.	Slight-----------	Poor: too sandy.
Superstition-------	Slight-----------	Severe: seepage.	Severe: too sandy.	Slight-----------	Poor: too sandy.
Superstition-------	Slight-----------	Severe: seepage.	Severe: too sandy.	Slight-----------	Poor: too sandy.
30*:					
Torriorthents.					
Torrifluvents.					
31*:					
Tremant------------	Moderate: percs slowly.	Moderate: slope, seepage.	Slight-----------	Slight-----------	Fair: small stones.
Rositas------------	Moderate: slope.	Severe: seepage, slope.	Severe: too sandy.	Moderate: slope.	Poor: too sandy.

See footnote at end of table.

TABLE 11.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
32 Vint	Slight	Severe: seepage.	Moderate: too sandy.	Slight	Fair: too sandy.
33 Wellton	Slight	Severe: seepage.	Slight	Slight	Fair: small stones.
34*:					
Wellton	Slight	Severe: seepage.	Slight	Slight	Fair: small stones.
Dateland	Slight	Severe: seepage.	Slight	Slight	Good.
Rositas	Moderate: slope.	Severe: seepage, slope.	Severe: too sandy.	Moderate: slope.	Poor: too sandy.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 12.--CONSTRUCTION MATERIALS

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "good," "fair," and "poor." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
1, 2 Antho	Good	Unsuited: excess fines.	Unsuited: excess fines.	Good.
3 Carrizo	Good	Good	Good	Poor: too sandy, small stones.
4*:				
Cherioni	Poor: slope, thin layer, area reclaim.	Unsuited: thin layer, excess fines.	Unsuited: thin layer, excess fines.	Poor: slope, area reclaim, small stones.
Rock outcrop.				
5, 6 Dateland	Good	Poor: excess fines.	Unsuited: excess fines.	Good.
7 Gachado	Poor: thin layer, area reclaim.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: small stones, area reclaim.
8 Gadsden	Poor: shrink-swell, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: too clayey.
9 Gilman	Fair: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
10 Glenbar	Poor: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Fair: too clayey.
11*:				
Harqua	Fair: low strength, shrink-swell.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: excess salt, small stones.
Tremant	Fair: shrink-swell, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: small stones.
12 Holtville	Poor: shrink-swell, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: too clayey.
13 Indio	Fair: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
14, 15 Indio	Fair: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: excess salt.
16*:				
Indio	Fair: low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Good.
Lagunita	Good	Fair: excess fines.	Unsuited: excess fines.	Poor: too sandy.
Ripley	Fair: low strength.	Poor: excess fines.	Unsuited: excess fines.	Good.
17 Kofa	Good	Fair: excess fines.	Unsuited: excess fines.	Poor: too clayey.

See footnote at end of table.

TABLE 12.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
18, 19 Lagunita	Good	Fair: excess fines.	Unsuited: excess fines.	Poor: too sandy.
20*:				
Laposa	Poor: slope, area reclaim, thin layer.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: slope, small stones.
Rock outcrop.				
21*:				
Ligurta	Fair: shrink-swell.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: excess salt, small stones.
Cristobal	Fair: shrink-swell.	Poor: excess fines.	Poor: excess fines.	Poor: excess salt, small stones, area reclaim.
22, 23*. Pits				
24 Ripley	Fair: low strength.	Poor: excess fines.	Unsuited: excess fines.	Good.
25 Rositas	Good	Poor: excess fines.	Unsuited: excess fines.	Poor: too sandy.
26*:				
Rositas	Good	Poor: excess fines.	Unsuited: excess fines.	Poor: too sandy.
Ligurta	Fair: shrink-swell.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: excess salt, small stones.
27*. Salorthids				
28 Superstition	Good	Poor: excess fines.	Unsuited: excess fines.	Poor: too sandy.
29*:				
Superstition	Good	Poor: excess fines.	Unsuited: excess fines.	Poor: too sandy.
Superstition	Good	Poor: excess fines.	Unsuited: excess fines.	Poor: too sandy.
Superstition	Good	Poor: excess fines.	Unsuited: excess fines.	Poor: too sandy.
30*:				
Torriorthents.				
Torrifluvents.				
31*:				
Tremant	Fair: shrink-swell, low strength.	Unsuited: excess fines.	Unsuited: excess fines.	Poor: small stones.
Rositas	Good	Poor: excess fines.	Unsuited: excess fines.	Poor: too sandy.

See footnote at end of table.

TABLE 12.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
32 Vint	Good	Poor: excess fines.	Unsuited: excess fines.	Poor: too sandy.
33 Wellton	Good	Poor: excess fines.	Unsuited: excess fines.	Poor: small stones.
34*:				
Wellton	Good	Poor: excess fines.	Unsuited: excess fines.	Poor: small stones.
Dateland	Good	Poor: excess fines.	Unsuited: excess fines.	Good.
Rositas	Good	Poor: excess fines.	Unsuited: excess fines.	Poor: too sandy.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 13.--WATER MANAGEMENT

[Some terms that describe restrictive soil features are defined in the Glossary. Absence of an entry indicates that the soil was not evaluated]

Soil name and map symbol	Embankments, dikes, and levees	Drainage	Irrigation
1, 2 Antho	Favorable	Favorable	Favorable.
3 Carrizo	Seepage	Slope	Droughty, slope, rooting depth.
4*:			
Cherioni	Thin layer	Depth to rock, slope, cemented pan.	Droughty, rooting depth, slope.
Rock outcrop.			
5, 6 Dateland	Piping, seepage.	Favorable	Soil blowing.
7 Gachado	Thin layer	Slope, depth to rock.	Rooting depth, slope, small stones.
8 Gadsden	Hard to pack	Percs slowly	Slow intake, percs slowly.
9 Gilman	Piping	Favorable	Favorable.
10 Glenbar	Favorable	Favorable	Favorable.
11*:			
Harqua	Excess salt	Excess salt	Excess salt.
Tremant	Piping	Favorable	Favorable.
12 Holtville	Low strength, piping, shrink-swell.	Percs slowly	Percs slowly.
13 Indio	Piping, low strength.	Favorable	Favorable.
14, 15 Indio	Excess salt, piping.	Excess salt	Excess salt, soil blowing.
16*:			
Indio	Piping, low strength.	Favorable	Favorable.
Lagunita	Seepage, piping.	Favorable	Droughty, fast intake, soil blowing.
Ripley	Thin layer, seepage.	Favorable	Favorable.
17 Kofa	Seepage, piping.	Percs slowly	Slow intake, percs slowly.
18 Lagunita	Seepage, piping.	Favorable	Droughty, fast intake, soil blowing.

See footnote at end of table.

TABLE 13.--WATER MANAGEMENT--Continued

Soil name and map symbol	Embankments, dikes, and levees	Drainage	Irrigation
19: Lagunita	Seepage, piping.	Favorable	Droughty.
20*:			
Laposa	Thin layer, large stones.	Slope, depth to rock.	Slope, large stones, rooting depth.
Rock outcrop.			
21*:			
Ligurta	Excess salt	Excess salt, slope.	Excess salt, droughty, slope.
Cristobal	Excess salt	Excess salt, slope.	Excess salt, slope, droughty.
22, 23*. Pits			
24: Ripley	Thin layer, seepage.	Favorable	Favorable.
25: Rositas	Seepage, piping.	Slope	Droughty, fast intake, slope.
26*:			
Rositas	Seepage, piping.	Slope	Droughty, fast intake, slope.
Ligurta	Excess salt	Excess salt, slope.	Excess salt, droughty, slope.
27*. Salorthids			
28: Superstition	Seepage, piping.	Favorable	Fast intake, droughty, soil blowing.
29*:			
Superstition	Seepage, piping.	Favorable	Fast intake, droughty, soil blowing.
Superstition	Seepage, piping.	Favorable	Fast intake, droughty, soil blowing.
Superstition	Seepage, piping.	Favorable	Fast intake, droughty, soil blowing.
30*:			
Torriorthents.			
Torrifluvents.			
31*:			
Tremant	Piping	Favorable	Favorable.
Rositas	Seepage, piping.	Slope	Droughty, fast intake, slope.

See footnote at end of table.

TABLE 13.--WATER MANAGEMENT--Continued

Soil name and map symbol	Embankments, dikes, and levees	Drainage	Irrigation
32----------------- Vint	Piping, seepage.	Favorable----------------------	Droughty.
33----------------- Wellton	Piping-------------------------	Favorable----------------------	Droughty, soil blowing.
34*:			
Wellton----------	Piping-------------------------	Favorable----------------------	Droughty, soil blowing.
Dateland---------	Piping, seepage.	Favorable----------------------	Soil blowing.
Rositas----------	Seepage, piping.	Slope--------------------------	Droughty, fast intake, slope.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 14.--ENGINEERING INDEX PROPERTIES

[The symbol > means more than. Absence of an entry indicates that data were not estimated]

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
1 Antho	0-4	Sandy loam	SM	A-2	0	90-100	80-90	55-65	25-35	---	NP
	4-60	Sandy loam, fine sandy loam.	SM	A-2	0	90-100	80-90	55-65	25-30	---	NP
2 Antho	0-3	Fine sandy loam	SM	A-4	0	90-100	80-90	65-75	45-50	---	NP
	3-60	Sandy loam, fine sandy loam, gravelly sandy loam.	SM	A-2, A-4, A-1	0	70-100	65-95	35-60	15-40	---	NP
3 Carrizo	0-3	Very gravelly sand.	SP-SM, GP, GP-GM	A-1	0-10	55-65	50-55	15-35	0-15	---	NP
	3-64	Very gravelly coarse sand, very gravelly sand, very gravelly loamy sand.	GP, GP-GM, SP, SP-SM	A-1	0-25	30-65	15-60	5-35	0-15	---	NP
4*: Cherioni	0-6	Extremely cobbly loam.	GM	A-1	35-80	40-65	30-45	20-30	15-25	20-30	NP-5
	6-13	Extremely gravelly loam.	GP-GM, GM	A-1	15-35	30-40	25-50	15-25	5-15	15-20	NP-5
	13-15	Indurated	---	---	---	---	---	---	---	---	---
	15	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Rock outcrop.											
5 Dateland	0-6	Loamy fine sand	SM	A-2	0	90-100	85-95	50-60	15-30	---	NP
	6-38	Fine sandy loam, loam.	SM, SM-SC	A-2	0	95-100	90-95	55-65	25-35	20-30	NP-10
	38-60	Gravelly sandy loam, sandy loam.	SM, SM-SC	A-2, A-1	0	70-80	50-80	30-50	15-30	20-30	NP-10
6 Dateland	0-6	Fine sandy loam	SM, SM-SC	A-2	0	90-100	85-95	60-70	25-35	20-30	NP-10
	6-27	Fine sandy loam	SM, SM-SC	A-2	0	95-100	90-95	55-65	25-35	20-30	NP-10
	27-54	Loam	ML, CL-ML	A-4	0	95-100	90-95	75-85	50-70	20-30	NP-10
	54-60	Fine sandy loam	SM, SM-SC	A-2	0	90-100	85-95	60-70	25-35	20-30	NP-10
7 Gachado	0-1	Very gravelly loam.	SM-SC, GM-GC	A-2, A-1	20-40	50-60	30-35	25-30	15-20	15-25	5-10
	1-6	Extremely gravelly sandy clay loam.	GC, SC	A-2	35-55	35-80	25-40	20-35	20-35	30-40	10-20
	6-12	Extremely gravelly loam.	GC, SC	A-2	35-55	50-60	20-35	20-25	15-20	30-40	10-15
	12	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
8 Gadsden	0-10	Clay	CH	A-7	0	100	100	90-100	80-90	50-60	25-35
	10-60	Clay, silty clay loam.	CH	A-7	0	100	100	90-100	80-90	50-60	25-35
9 Gilman	0-15	Loam	ML, SM, SM-SC, CL-ML	A-4	0	100	95-100	70-100	40-75	20-30	NP-7
	15-24	Very fine sandy loam.	ML	A-4	0	100	95-100	80-100	60-75	25-35	NP-10
	24-60	Fine sandy loam	SM, SM-SC	A-4	0	100	95-100	75-90	40-50	20-30	NP-10

See footnote at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
10------------------ Glenbar	0-16	Silty clay loam	CL	A-6	0	100	100	90-100	70-95	35-45	15-30
	16-60	Silty clay loam	CL	A-6	0	100	100	90-100	75-95	35-45	15-30
11*:											
Harqua------------	0-5	Gravelly loam---	ML	A-4	0-5	90-100	65-75	60-70	50-55	30-40	5-10
	5-32	Gravelly clay loam, clay loam.	CL, SC	A-6	0	90-100	55-80	50-70	45-65	30-40	10-20
	32-60	Clay loam, gravelly clay loam.	CL	A-6	0	90-100	85-95	80-90	70-80	30-40	10-20
Tremant-----------	0-12	Loam------------	ML	A-4	0-5	90-100	80-95	70-80	60-70	30-40	5-10
	12-23	Gravelly sandy clay loam.	CL, SC	A-6	0-10	70-95	50-90	50-70	45-60	30-40	10-20
	23-60	Gravelly clay loam.	CL, SC	A-6	0-10	80-90	50-75	50-70	45-55	20-30	10-20
12------------------ Holtville	0-13	Clay------------	CH	A-7	0	100	100	95-100	85-95	55-75	35-50
	13-23	Clay------------	CH	A-7	0	100	100	95-100	85-95	55-75	35-50
	23-75	Very fine sandy loam, silty clay loam.	ML	A-4	0	100	100	95-100	65-85	25-35	NP-10
13------------------ Indio	0-6	Silt loam-------	ML	A-4	0	95-100	95-100	85-100	75-90	20-30	NP-5
	6-63	Stratified very fine sandy loam to silt.	ML	A-4	0	95-100	95-100	85-100	75-90	20-30	NP-5
14------------------ Indio	0-12	Silt loam-------	ML	A-4	0	100	100	90-100	75-90	20-30	NP-5
	12-60	Stratified very fine sandy loam to silt.	ML	A-4	0	100	100	90-100	85-90	20-30	NP-5
15------------------ Indio	0-4	Silt loam-------	ML	A-4	0	100	100	90-100	75-90	20-30	NP-5
	4-60	Stratified very fine sandy loam to silt.	ML	A-4	0	100	100	90-100	85-90	20-30	NP-5
16*:											
Indio-------------	0-6	Silt loam-------	ML	A-4	0	95-100	95-100	85-100	75-90	20-30	NP-5
	6-63	Stratified very fine sandy loam to silt.	ML	A-4	0	95-100	95-100	85-100	75-90	20-30	NP-5
Lagunita----------	0-8	Loamy sand------	SM	A-1, A-2	0	95-100	80-90	45-55	15-30	---	NP
	8-60	Loamy sand------	SM	A-1, A-2	0	95-100	80-90	45-55	15-30	---	NP
Ripley------------	0-6	Silt loam-------	CL-ML, ML	A-4	0	100	100	90-100	80-90	20-35	5-10
	6-25	Very fine sandy loam.	CL-ML, ML	A-4	0	100	100	90-100	80-90	20-35	5-10
	25-60	Sand------------	SM, SP-SM	A-2	0	100	100	50-80	10-20	---	NP
17------------------ Kofa	0-12	Clay------------	CH	A-7	0	100	100	95-100	85-95	55-75	35-50
	12-28	Clay------------	CH	A-7	0	100	100	95-100	85-95	55-75	35-50
	28-60	Sand------------	SM, SP-SM	A-2, A-3	0	100	100	60-80	5-15	<20	NP-5
18------------------ Lagunita	0-8	Loamy sand------	SM	A-1, A-2	0	95-100	80-90	45-55	15-30	---	NP
	8-60	Loamy sand------	SM	A-1, A-2	0	95-100	80-90	45-55	15-30	---	NP
19------------------ Lagunita	0-12	Silt loam-------	ML, CL-ML	A-4	0	100	100	95-100	85-95	20-30	NP-10
	12-60	Sand, loamy fine sand.	SP, SP-SM	A-1, A-2	0	70-90	65-75	30-40	0-10	---	NP
20*:											
Laposa------------	0-3	Extremely gravelly loam.	GM, SM	A-1	15-45	25-55	10-35	10-30	10-25	20-30	NP-5
	3-32	Extremely gravelly loam.	GM, SM	A-1	15-45	25-65	15-45	15-30	10-25	20-30	NP-5
	32	Unweathered bedrock.	---	---	---	---	---	---	---	---	---

See footnote at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
20*: Rock outcrop.											
21*: Ligurta-----------	0-2	Very gravelly loam.	GC, SC	A-2	0-5	50-60	30-35	20-25	15-20	30-40	10-15
	2-60	Gravelly clay loam, clay loam, gravelly loam.	GC, SC	A-2, A-6	0-5	50-80	50-80	45-75	25-50	30-40	10-20
Cristobal---------	0-2	Very gravelly loam.	GM, GM-GC, SM, SM-SC	A-1, A-2	0-5	50-60	30-35	20-25	15-20	20-25	NP-10
	2-25	Very gravelly clay loam, extremely gravelly clay loam, gravelly sandy clay loam	GM, GM-GC, SM, SM-SC	A-1, A-2	0-5	40-70	10-55	10-30	15-20	20-30	NP-10
	25-60	Very gravelly clay loam, gravelly clay loam.	GC, SC	A-2, A-6	0-5	40-70	10-55	10-30	15-20	30-40	10-20
22, 23*. Pits											
24----------------- Ripley	0-6	Silt loam-------	CL-ML, ML	A-4	0	100	100	90-100	80-90	20-35	5-10
	6-25	Very fine sandy loam.	CL-ML, ML	A-4	0	100	100	90-100	80-90	20-35	5-10
	25-60	Sand------------	SM, SP-SM	A-2	0	100	100	50-80	10-20	---	NP
25----------------- Rositas	0-5	Sand------------	SM, SP-SM	A-2, A-3	0	100	80-100	50-70	5-25	---	NP
	5-60	Sand------------	SM, SP-SM	A-2, A-3	0	100	80-100	50-70	5-30	---	NP
26*: Rositas-----------	0-5	Sand------------	SM, SP-SM	A-2, A-3	0	100	80-100	50-70	5-25	---	NP
	5-60	Sand------------	SM, SP-SM	A-2, A-3	0	100	80-100	50-70	5-30	---	NP
Ligurta-----------	0-2	Very gravelly loam.	GC, SC	A-2	0-5	50-60	30-35	20-25	15-20	30-40	10-15
	2-60	Gravelly clay loam, clay loam, gravelly loam.	GC, SC	A-2, A-6	0-5	50-80	50-80	45-75	25-50	30-40	10-20
27*. Salorthids											
28----------------- Superstition	0-5	Sand------------	SM	A-2	0	100	80-100	50-70	15-25	---	NP
	5-60	Sand------------	SM	A-2	0	100	80-100	50-70	15-25	---	NP
29*: Superstition------	0-5	Clay------------	CH	A-7	0	100	100	90-100	80-90	50-60	25-35
	5-60	Sand------------	SM	A-2	0	100	95-100	70-85	15-25	---	NP
Superstition------	0-10	Sandy clay loam	SM-SC	A-4	0	100	100	80-90	35-50	25-30	5-10
	10-60	Sand------------	SM	A-2	0	100	95-100	70-85	15-25	---	NP
Superstition------	0-10	Loam------------	ML, CL-ML	A-4	0	100	100	90-100	70-80	20-30	NP-10
	10-60	Sand------------	SM	A-2	0	100	95-100	70-85	15-25	---	NP
30*: Torriorthents.											
Torrifluvents.											

See footnote at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
31*:											
Tremant-----------	0-2	Gravelly loam---	SM, SM-SC	A-4, A-2	0-5	90-100	45-75	35-60	25-50	20-30	NP-10
	2-60	Clay loam, gravelly loam, gravelly sandy clay loam.	CL, SC	A-6	0-10	70-95	50-90	50-70	45-60	30-40	10-20
Rositas-----------	0-5	Sand------------	SM, SP-SM	A-2, A-3	0	100	80-100	50-70	5-25	---	NP
	5-60	Sand------------	SM, SP-SM	A-2, A-3	0	100	80-100	50-70	5-30	---	NP
32----------------- Vint	0-16	Loamy fine sand	SM	A-2	0	95-100	95-100	70-80	25-35	---	NP
	16-60	Stratified loamy fine sand to silty clay loam	SM	A-2	0	95-100	95-100	70-80	20-30	---	NP
33----------------- Wellton	0-8	Loamy sand------	SM, SP-SM	A-1	0	90-100	70-90	30-40	5-15	---	NP
	8-60	Fine gravelly sandy loam, fine gravelly coarse sandy loam.	SM	A-1	0	85-95	50-75	30-50	15-25	15-20	NP-5
34*:											
Wellton-----------	0-8	Loamy sand------	SM, SP-SM	A-1	0	90-100	70-90	30-40	5-15	---	NP
	8-60	Gravelly sandy loam, loamy sand, sandy loam.	SM	A-1	0	85-95	50-75	30-50	15-25	15-20	NP-5
Dateland----------	0-6	Loamy fine sand	SM	A-2	0	90-100	85-95	50-60	15-30	---	NP
	6-27	Sandy loam------	SM, SM-SC	A-2	0	95-100	90-95	55-65	25-35	20-30	NP-10
	27-54	Loam------------	ML, CL-ML	A-4	0	95-100	90-95	75-85	50-70	20-30	NP-10
	54-60	Fine sandy loam, loam.	SM, SM-SC	A-2	0	70-80	50-80	30-50	15-30	20-30	NP-10
Rositas-----------	0-5	Sand------------	SM, SP-SM	A-2, A-3	0	100	80-100	50-70	5-25	---	NP
	5-60	Sand------------	SM, SP-SM	A-2, A-3	0	100	80-100	50-70	5-30	---	NP

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF SOILS

[The symbol < means less than; > means more than. Entries under "Erosion factors--T" apply to the entire profile. Entries under "Wind erodibility group" apply only to the surface layer. Absence of an entry indicates that data were not available or were not estimated]

Soil name and map symbol	Depth	Clay <2mm	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodibility group
	In	Pct	In/hr	In/in	pH	Mmhos/cm				
1	0-4	5-15	2.0-6.0	0.08-0.12	7.9-8.4	<4	Low	0.20	5	3
Antho	4-60	5-15	2.0-6.0	0.08-0.12	7.9-9.0	<4	Low	0.20		
2	0-3	5-15	2.0-6.0	0.08-0.12	7.9-8.4	<4	Low	0.20	5	3
Antho	3-60	5-15	2.0-6.0	0.08-0.12	7.9-9.0	<4	Low	0.20		
3	0-3	0-5	>20	0.03-0.04	7.9-8.4	<4	Low	0.10	5	7
Carrizo	3-64	0-5	>20	0.03-0.04	7.9-8.4	<4	Low	0.10		
4*:										
Cherioni	0-6	15-25	0.6-2.0	0.05-0.07	7.9-8.4	<4	Low	0.32	1	8
	6-13	10-20	0.6-2.0	0.05-0.07	7.9-8.4	<4	Low	0.32		
	13-15	---	---	---	---	---	---	---		
	15	---	---	---	---	---	---	---		
Rock outcrop.										
5	0-6	5-10	6.0-20	0.09-0.11	7.9-8.4	<4	Low	0.17	5	2
Dateland	6-38	10-20	2.0-6.0	0.11-0.15	7.9-8.4	<4	Low	0.24		
	38-60	10-20	2.0-6.0	0.12-0.14	7.9-8.4	<4	Low	0.24		
6	0-6	10-20	2.0-6.0	0.11-0.15	7.9-8.4	<4	Low	0.24	5	3
Dateland	6-27	10-20	2.0-6.0	0.11-0.15	7.9-8.4	<4	Low	0.24		
	27-54	10-15	2.0-6.0	0.14-0.16	7.9-8.4	<4	Low	0.32		
	54-60	10-20	2.0-6.0	0.12-0.14	7.9-8.4	<4	Low	0.24		
7	0-1	15-20	0.6-2.0	0.06-0.10	7.9-8.4	<2	Low	0.32	1	8
Gachado	1-6	25-35	0.06-0.2	0.10-0.19	7.9-8.4	<2	Moderate	0.32		
	6-12	25-30	0.06-0.2	0.06-0.08	7.9-8.4	<2	Low	0.28		
	12	---	---	---	---	---	---	---		
8	0-10	50-55	0.06-0.2	0.15-0.17	7.9-9.0	2-4	High	0.32	5	4
Gadsden	10-60	50-55	0.06-0.2	0.15-0.17	7.9-9.0	4-16	High	0.32		
9	0-15	10-15	0.6-2.0	0.16-0.18	7.9-8.4	<2	Low	0.37	5	4L
Gilman	15-24	10-15	0.6-2.0	0.16-0.18	7.9-8.4	<2	Low	0.49		
	24-60	10-15	0.6-2.0	0.15-0.17	7.9-8.4	<2	Low	0.49		
10	0-16	27-35	0.2-0.6	0.19-0.21	7.9-8.4	2-4	Moderate	0.37	5	4L
Glenbar	16-60	18-35	0.2-0.6	0.19-0.21	7.9-9.0	2-4	Moderate	0.37		
11*:										
Harqua	0-5	30-35	0.2-0.6	0.07-0.09	7.9-8.4	2-8	Low	0.28	5	4L
	5-32	30-35	0.2-0.6	0.06-0.08	7.9-8.4	8-16	Moderate	0.28		
	32-60	30-35	0.2-0.6	0.06-0.08	7.9-8.4	8-16	Moderate	0.43		
Tremant	0-12	10-20	0.6-2.0	0.08-0.18	7.9-8.4	<4	Low	0.32	5	4L
	12-23	30-35	0.2-0.6	0.12-0.21	7.9-8.4	<4	Moderate	0.28		
	23-60	10-25	0.6-2.0	0.10-0.15	7.9-8.4	<4	Low	0.32		
12	0-13	35-60	0.06-0.2	0.17-0.25	7.4-9.0	>2	High	0.32	5	4
Holtville	13-23	40-60	0.06-0.2	0.17-0.25	7.4-9.0	>2	High	0.32		
	23-75	10-25	0.6-2.0	0.15-0.25	7.4-9.0	>2	Low	0.43		
13	0-6	8-18	0.6-2.0	0.18-0.20	7.9-9.0	<4	Low	0.55	5	4L
Indio	6-63	8-18	0.6-2.0	0.16-0.20	7.9-9.0	<4	Low	0.49		
14	0-12	10-25	0.6-2.0	0.05-0.14	7.9-9.0	4-16	Low	0.55	5	4L
Indio	12-60	5-20	0.6-2.0	0.05-0.14	7.9-9.0	4-16	Low	0.49		
15	0-4	5-20	0.6-2.0	0.02-0.05	7.9-9.0	>16	Low	0.55	5	4L
Indio	4-60	5-20	0.6-2.0	0.02-0.05	7.9-9.0	>16	Low	0.49		

See footnote at end of table.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF SOILS--Continued

Soil name and map symbol	Depth	Clay <2mm	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodibility group
	In	Pct	In/hr	In/in	pH	Mmhos/cm				
16*:										
Indio-----------	0-6	8-18	0.6-2.0	0.18-0.20	7.9-9.0	<4	Low-----------	0.55	5	4L
	6-63	8-18	0.6-2.0	0.16-0.20	7.9-9.0	<4	Low-----------	0.49		
Lagunita--------	0-8	0-5	6.0-20.0	0.05-0.11	7.9-8.4	<4	Low-----------	0.1	5	2
	8-60	0-5	6.0-20.0	0.05-0.07	7.9-8.4	<4	Low-----------	0.1		
Ripley----------	0-6	5-18	0.6-2.0	0.11-0.14	7.9-8.4	<4	Low-----------	0.43	5	4L
	6-25	5-18	0.6-2.0	0.11-0.14	7.9-8.4	<4	Low-----------	0.43		
	25-60	5-10	6.0-20	0.05-0.07	7.9-8.4	<4	Low-----------	0.20		
17--------------- Kofa	0-12	50-55	0.06-0.2	0.14-0.16	7.9-8.4	<4	High----------	0.32	5	4
	12-28	50-55	0.06-0.2	0.14-0.16	7.9-8.4	<4	High----------	0.32		
	28-60	5-10	6.0-20.0	0.04-0.07	7.9-8.4	<4	Low-----------	0.10		
18--------------- Lagunita	0-8	0-5	6.0-20.0	0.05-0.11	7.9-8.4	<4	Low-----------	0.1	5	2
	8-60	0-5	6.0-20.0	0.05-0.07	7.9-8.4	<4	Low-----------	0.1		
19--------------- Lagunita	0-12	5-15	0.6-2.0	0.19-0.21	7.9-8.4	<4	Low-----------	0.3	5	4L
	12-60	0-5	6.0-20.0	0.05-0.07	7.9-8.4	<4	Low-----------	0.1		
20*:										
Laposa----------	0-3	15-25	0.6-2.0	0.05-0.10	7.9-8.4	<2	Low-----------	0.32	2	8
	3-32	15-25	0.6-2.0	0.05-0.10	7.9-8.4	<2	Low-----------	0.32		
	32	---	---	---	---	---	-------------	---		
Rock outcrop.										
21*:										
Ligurta---------	0-2	20-30	0.6-2.0	0.02-0.03	>7.9	2-8	Moderate-----	0.28	5	8
	2-60	20-35	0.2-0.6	0.02-0.03	>7.9	>16	Moderate-----	0.28		
Cristobal-------	0-2	18-27	0.6-2.0	0.01-0.02	7.9-8.4	2-8	Low-----------	0.28	5	8
	2-25	20-30	0.2-0.6	0.01-0.03	7.9-8.4	>16	Low-----------	0.24		
	25-60	25-35	0.2-0.6	0.01-0.03	7.9-8.4	>16	Moderate-----	0.24		
22, 23*. Pits										
24--------------- Ripley	0-6	5-18	0.6-2.0	0.11-0.14	7.9-8.4	<4	Low-----------	0.43	5	4L
	6-25	5-18	0.6-2.0	0.11-0.14	7.9-8.4	<4	Low-----------	0.43		
	25-60	5-10	6.0-20	0.05-0.07	7.9-8.4	<4	Low-----------	0.20		
25--------------- Rositas	0-5	0-5	6.0-20	0.05-0.07	7.9-8.4	2-4	Low-----------	0.15	5	1
	5-60	0-5	6.0-20	0.05-0.08	7.9-8.4	2-4	Low-----------	0.15		
26*:										
Rositas---------	0-5	0-5	6.0-20	0.05-0.07	7.9-8.4	2-4	Low-----------	0.15	5	1
	5-60	0-5	6.0-20	0.05-0.08	7.9-8.4	2-4	Low-----------	0.15		
Ligurta---------	0-2	20-30	0.6-2.0	0.02-0.03	>7.9	2-8	Moderate-----	0.28	5	8
	2-60	20-35	0.2-0.6	0.02-0.03	>7.9	>16	Moderate-----	0.28		
27*. Salorthids										
28--------------- Superstition	0-5	0-5	2.0-6.0	0.05-0.11	7.9-8.4	<2	Low-----------	0.15	5	1
	5-60	0-5	6.0-20	0.05-0.11	7.9-8.4	<2	Low-----------	0.15		
29*:										
Superstition----	0-5	40-50	0.06-0.2	0.14-0.16	7.9-8.4	<2	High----------	0.28	5	4
	5-60	0-5	6.0-20	0.05-0.11	7.9-8.4	<2	Low-----------	0.15		
Superstition----	0-10	25-35	0.6-2.0	0.14-0.16	7.9-8.4	<2	High----------	0.28	5	4L
	10-60	0-5	6.0-20	0.05-0.11	7.9-8.4	<2	Low-----------	0.15		
Superstition----	0-10	10-20	0.6-2.0	0.13-0.18	7.9-8.4	<2	Low-----------	0.28	5	4L
	10-60	0-5	6.0-20	0.05-0.11	7.9-8.4	<2	Low-----------	0.15		

See footnote at end of table.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF SOILS--Continued

Soil name and map symbol	Depth	Clay <2mm	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodibility group
	In	Pct	In/hr	In/in	pH	Mmhos/cm				
30*:										
Torriorthents.										
Torrifluvents.										
31*:										
Tremant----------	0-2	10-20	0.6-2.0	0.08-0.18	7.9-8.4	<4	Low-----------	0.32	5	4L
	2-60	30-35	0.2-0.6	0.12-0.21	7.9-8.4	<4	Moderate------	0.28		
Rositas----------	0-5	0-5	6.0-20	0.05-0.07	7.9-8.4	2-4	Low-----------	0.15	5	1
	5-60	0-5	6.0-20	0.05-0.08	7.9-8.4	2-4	Low-----------	0.15		
32---------------- Vint	0-16	5-10	2.0-6.0	0.09-0.11	7.9-8.4	2-4	Low-----------	0.24	5	5
	16-60	5-10	2.0-6.0	0.09-0.11	7.9-8.4	2-4	Low-----------	0.24		
33---------------- Wellton	0-8	2-10	2.0-6.0	0.05-0.08	7.9-8.4	<4	Low-----------	0.17	5	2
	8-60	10-20	2.0-6.0	0.07-0.11	7.9-8.4	<4	Low-----------	0.17		
34*:										
Wellton----------	0-8	2-10	2.0-6.0	0.05-0.08	7.9-8.4	<4	Low-----------	0.17	5	2
	8-60	10-20	2.0-6.0	0.07-0.11	7.9-8.4	<4	Low-----------	0.17		
Dateland---------	0-6	5-10	6.0-20	0.09-0.11	7.9-8.4	<4	Low-----------	0.17	5	2
	6-27	10-20	2.0-6.0	0.11-0.15	7.9-8.4	<4	Low-----------	0.24		
	27-54	10-15	2.0-6.0	0.14-0.16	7.9-8.4	<4	Low-----------	0.32		
	54-60	10-20	2.0-6.0	0.12-0.14	7.9-8.4	<4	Low-----------	0.24		
Rositas----------	0-5	0-5	6.0-20	0.05-0.07	7.9-8.4	2-4	Low-----------	0.15	5	1
	5-60	0-5	6.0-20	0.05-0.08	7.9-8.4	2-4	Low-----------	0.15		

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 16.--SOIL AND WATER FEATURES

[The definitions of "flooding" in the Glossary explain terms such as "rare." The symbol > means more than. Absence of an entry indicates that the feature is not a concern]

Soil name and map symbol	Hydrologic group	Flooding	Bedrock		Cemented pan		Risk of corrosion	
		Frequency	Depth	Hardness	Depth	Hardness	Uncoated steel	Concrete
			In		In			
1, 2------------------- Antho	B	None---------	>60	---	---	---	High------	Low.
3---------------------- Carrizo	A	Rare---------	>60	---	---	---	High------	Low.
4*:								
Cherioni--------------	D	None---------	6-20	Hard	5-12	Hard	High------	Low.
Rock outcrop.								
5, 6------------------- Dateland	B	None---------	>60	---	---	---	High------	Low.
7---------------------- Gachado	D	None---------	9-20	Hard	---	---	High------	Low.
8---------------------- Gadsden	D	None---------	>60	---	---	---	High------	Moderate.
9---------------------- Gilman	B	None---------	>60	---	---	---	High------	Low.
10--------------------- Glenbar	B	None---------	>60	---	---	---	High------	Low.
11*:								
Harqua----------------	C	None---------	>60	---	---	---	High------	High.
Tremant---------------	B	None---------	>60	---	---	---	High------	Low.
12--------------------- Holtville	C	None---------	>60	---	---	---	High------	Low.
13, 14----------------- Indio	B	None---------	>60	---	---	---	High------	Low.
15--------------------- Indio	B	Rare---------	>60	---	---	---	High------	High.
16*:								
Indio-----------------	B	Rare---------	>60	---	---	---	High------	Low.
Lagunita--------------	A	Rare---------	>60	---	---	---	High------	Low.
Ripley----------------	B	None---------	>60	---	---	---	High------	Low.
17--------------------- Kofa	D	None---------	>60	---	---	---	High------	Low.
18, 19----------------- Lagunita	A	None---------	>60	---	---	---	High------	Low.
20*:								
Laposa----------------	C	None---------	20-40	Hard	---	---	High------	Low.
Rock outcrop.								
21*:								
Ligurta---------------	B	None---------	>60	---	---	---	High------	High.
Cristobal-------------	B	None---------	>60	---	---	---	High------	High.

See footnote at end of table.

TABLE 16.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding	Bedrock		Cemented pan		Risk of corrosion	
		Frequency	Depth	Hardness	Depth	Hardness	Uncoated steel	Concrete
			In		In			
22, 23*. Pits								
24----------------------- Ripley	B	None---------	>60	---	---	---	High-------	Low.
25----------------------- Rositas	A	None---------	>60	---	---	---	High-------	Low.
26*:								
Rositas----------------	A	None---------	>60	---	---	---	High-------	Low.
Ligurta----------------	B	None---------	>60	---	---	---	High-------	High.
27*. Salorthids								
28----------------------- Superstition	A	None---------	>60	---	---	---	Moderate	Low.
29*:								
Superstition-----------	A	None---------	>60	---	---	---	Moderate	Low.
Superstition-----------	A	None---------	>60	---	---	---	Moderate	Low.
Superstition-----------	A	None---------	>60	---	---	---	Moderate	Low.
30*:								
Torriorthents.								
Torrifluvents.								
31*:								
Tremant----------------	B	None---------	>60	---	---	---	High-------	Low.
Rositas----------------	A	None---------	>60	---	---	---	High-------	Low.
32----------------------- Vint	B	None---------	>60	---	---	---	High-------	Low.
33----------------------- Wellton	B	None---------	>60	---	---	---	High-------	Low.
34*:								
Wellton----------------	B	None---------	>60	---	---	---	High-------	Low.
Dateland---------------	B	None---------	>60	---	---	---	High-------	Low.
Rositas----------------	A	None---------	>60	---	---	---	High-------	Low.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 17.--CLASSIFICATION OF THE SOILS

Soil name	Family or higher taxonomic class
Antho	Coarse-loamy, mixed (calcareous), hyperthermic Typic Torrifluvents
Carrizo	Sandy-skeletal, mixed, hyperthermic Typic Torriorthents
Cherioni	Loamy-skeletal, mixed, hyperthermic, shallow Typic Durorthids
Cristobal	Loamy-skeletal, mixed, hyperthermic Typic Haplargids
Dateland	Coarse-loamy, mixed, hyperthermic Typic Camborthids
Gachado	Loamy-skeletal, mixed, hyperthermic Lithic Haplargids
Gadsden	Fine, montmorillonitic (calcareous), hyperthermic Vertic Torrifluvents
Gilman	Coarse-loamy, mixed (calcareous), hyperthermic Typic Torrifluvents
Glenbar	Fine-silty, mixed (calcareous), hyperthermic Typic Torrifluvents
Harqua	Fine-loamy, mixed, hyperthermic Typic Haplargids
Holtville	Clayey over loamy, montmorillonitic (calcareous), hyperthermic Typic Torrifluvents
Indio	Coarse-silty, mixed (calcareous), hyperthermic Typic Torrifluvents
Kofa	Clayey over sandy or sandy-skeletal, montmorillonitic (calcareous), hyperthermic Vertic Torrifluvents
Lagunita	Mixed, hyperthermic Typic Torripsamments
Laposa	Loamy-skeletal, mixed (calcareous), hyperthermic Typic Torriorthents
Ligurta	Fine-loamy, mixed, hyperthermic Typic Haplargids
Ripley	Coarse-silty over sandy or sandy-skeletal, mixed (calcareous), hyperthermic Typic Torrifluvents
Rositas	Mixed, hyperthermic Typic Torripsamments
Superstition	Sandy, mixed, hyperthermic Typic Calciorthids
Tremant	Fine-loamy, mixed, hyperthermic Typic Haplargids
Vint	Sandy, mixed, hyperthermic Typic Torrifluvents
Wellton	Coarse-loamy, mixed, hyperthermic Typic Haplargids

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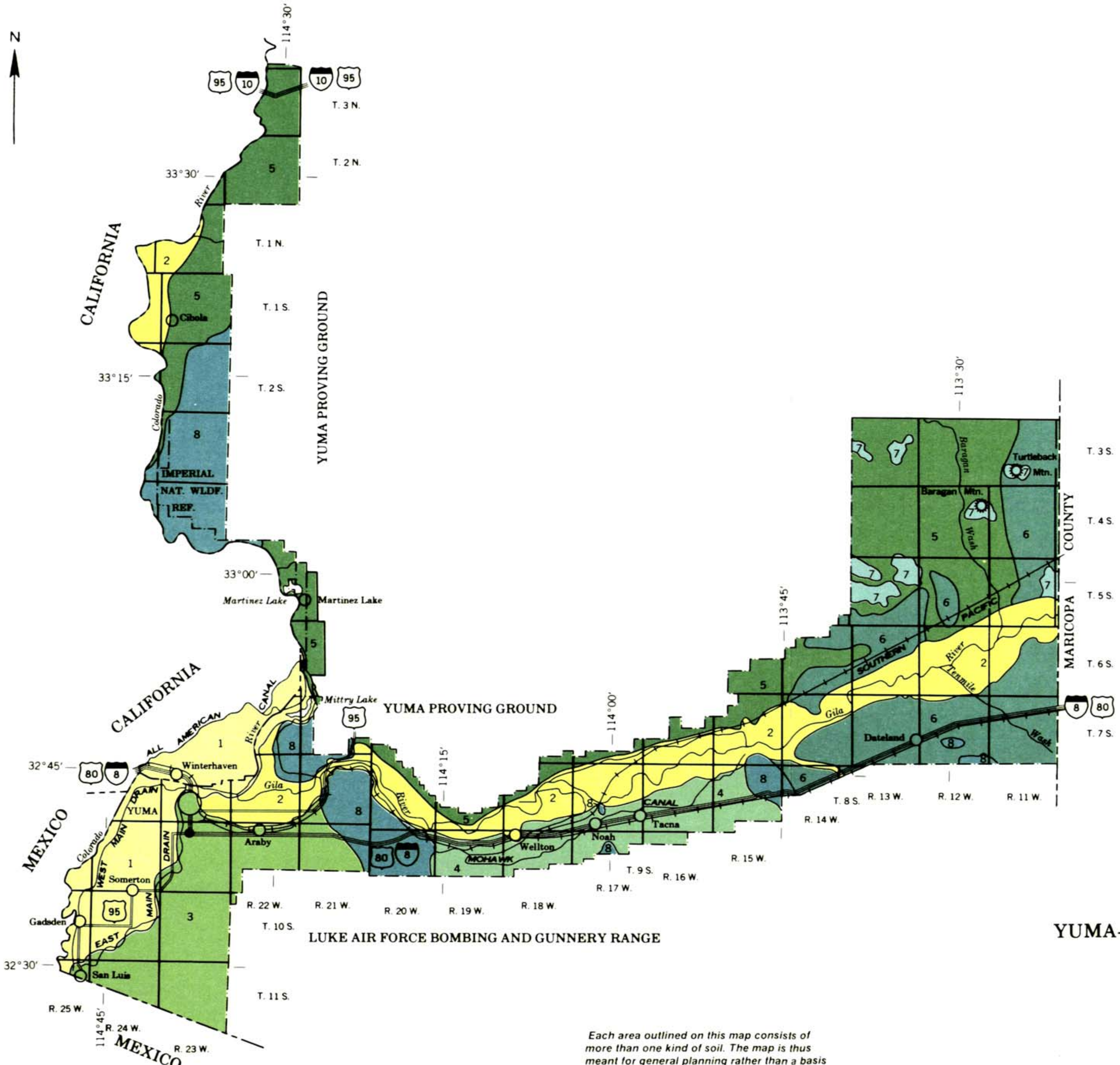


Each area outlined on this map consists of more than one kind of soil. The map is thus meant for general planning rather than a basis for decisions on the use of specific tracts.

MAP UNITS

1	Holtville-Gadsden-Kofa: Deep, nearly level, well drained, clayey soils; on flood plains and low terraces
2	Indio-Ripley-Lagunita: Deep, nearly level to gently sloping, well drained and somewhat excessively drained, silty and sandy soils; on flood plains, low terraces, and alluvial fans and in drainageways
3	Rositas-Superstition: Deep, nearly level and undulating, somewhat excessively drained, sandy soils; on old terraces, alluvial fans, and sand dunes
4	Dateland-Wellton: Deep, nearly level, well drained, loamy soils; on old alluvial fans and high terraces
5	Ligurta-Cristobal-Carrizo: Deep, nearly level, well drained and excessively drained, gravelly and very gravelly soils; on alluvial fans, low terraces, and flood plains
6	Tremant-Harqua-Rositas: Deep, nearly level, well drained and somewhat excessively drained, gravelly and sandy soils; on terraces, alluvial fans, and sand dunes
7	Cherioni-Rock outcrop: Very shallow and shallow, gently sloping to steep, well drained, extremely cobbly soils, and Rock outcrop; on hills and mountains
8	Laposa-Rock outcrop: Moderately deep, steep, well drained, extremely gravelly soils, and Rock outcrop; on hills and mountains

* The terms for texture used in the descriptive heading apply to the surface layer of the major soils.

Compiled 1979

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
ARIZONA AGRICULTURAL EXPERIMENT STATION
CALIFORNIA AGRICULTURAL EXPERIMENT STATION

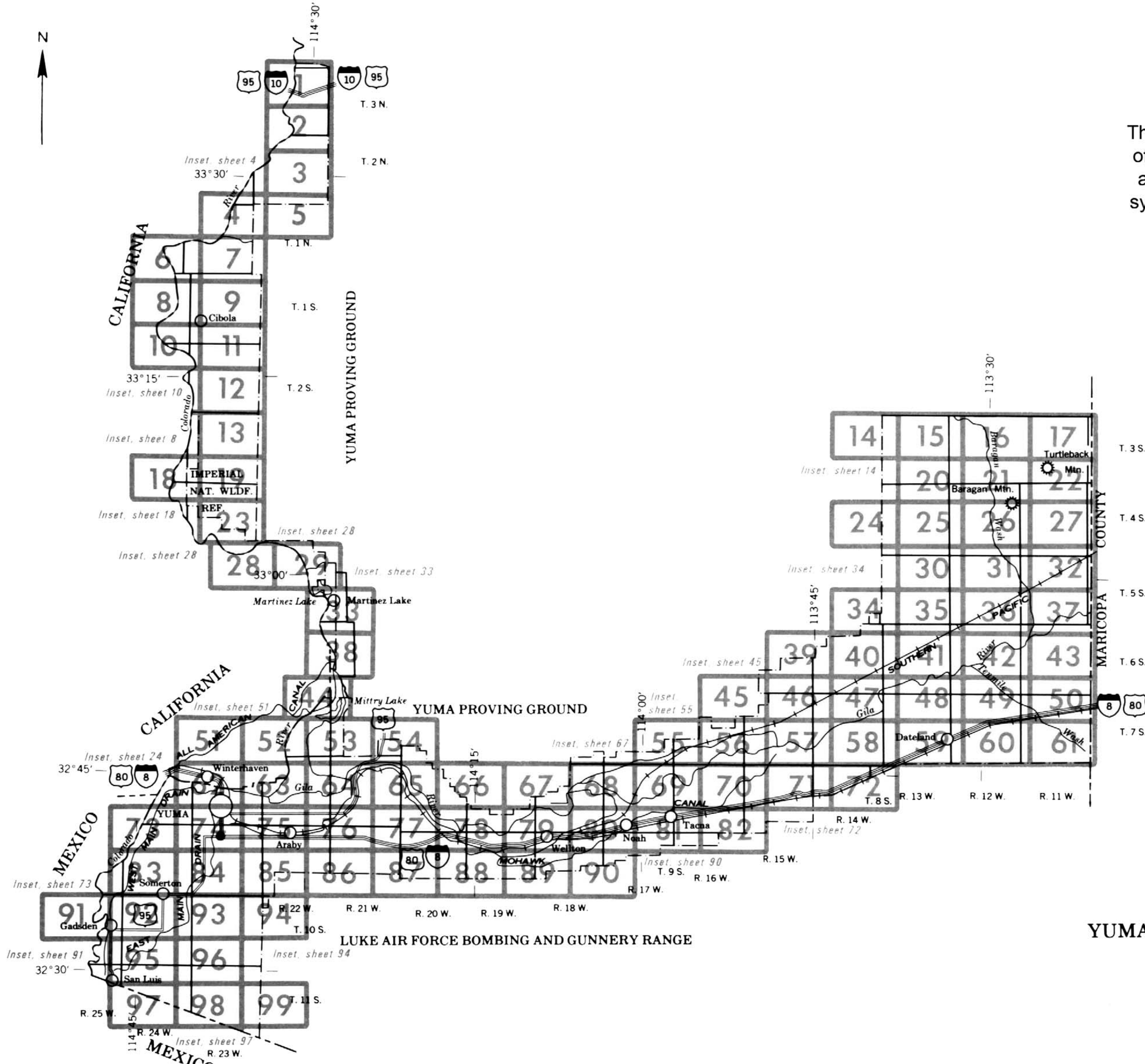
GENERAL SOIL MAP

YUMA-WELLTON AREA, ARIZONA-CALIFORNIA, PARTS OF YUMA COUNTY, ARIZONA AND IMPERIAL COUNTY, CALIFORNIA

SCALE 1: 633,360

10 0 10 20 Miles

Original text from each individual map sheet read:
This soil survey map was compiled by the U.S. Department of Agriculture, Soil Conservation Service, and cooperating agencies. 5,000-foot grid ticks based on state coordinate system. Land division corners, if shown, are approximately positioned.



INDEX TO MAP SHEETS

YUMA-WELLTON AREA, ARIZONA - CALIFORNIA, PARTS OF YUMA COUNTY, ARIZONA AND IMPERIAL COUNTY, CALIFORNIA

SCALE 1: 633,360

SOIL LEGEND

The publication symbols are numeric and the map unit names are in alphabetical order.

SYMBOL	NAME
1	Antho sandy loam
2	Antho fine sandy loam
3	Carrizo very gravelly sand
4	Cherioni-Rock outcrop complex, 25 to 70 percent slopes
5	Dateland loamy fine sand
6	Dateland fine sandy loam
7	Gachado very gravelly loam
8	Gadsden clay
9	Gilman loam
10	Glenbar silty clay loam
11	Harqua-Tremant complex
12	Holtville clay
13	Indio silt loam
14	Indio silt loam, saline
15	Indio silt loam, strongly saline
16	Indio-Lagunita-Ripley complex
17	Kofa clay
18	Lagunita loamy sand
19	Lagunita silt loam
20	Laposa-Rock outcrop complex, 15 to 75 percent slopes
21	Ligurta-Cristobal complex, 2 to 6 percent slopes
22	Pits, borrow
23	Pits, gravel
24	Ripley silt loam
25	Rositas sand
26	Rositas-Ligurta complex
27	Salorthids, nearly level
28	Superstition sand
29	Superstition complex
30	Torriorthents-Torrifluvents complex, 1 to 50 percent slopes
31	Tremant-Rositas complex
32	Vint loamy fine sand
33	Wellton loamy sand
34	Wellton-Dateland-Rositas complex

CONVENTIONAL AND SPECIAL SYMBOLS LEGEND

CULTURAL FEATURES

BOUNDARIES

- National, state or province
- County or parish
- Minor civil division
- Reservation (national forest or park, state forest or park, and large airport)
- Land grant
- Limit of soil survey (label)
- Field sheet matchline & neatline

AD HOC BOUNDARY (label)

- Small airport, airfield, park, oilfield, cemetery, or flood pool — Davis Airstrip; FLOOD POOL LINE

STATE COORDINATE TICK

LAND DIVISION CORNERS (sections and land grants)

ROADS

- Divided (median shown if scale permits)
- Other roads
- Trail

ROAD EMBLEMS & DESIGNATIONS

- Interstate — 79
- Federal — 410
- State — 52
- County, farm or ranch — 378

RAILROAD

POWER TRANSMISSION LINE (normally not shown)

PIPE LINE (normally not shown)

FENCE (normally not shown)

LEVEES

- Without road
- With road
- With railroad

DAMS

- Large (to scale)
- Medium or small — water; w

PITS

- Gravel pit — G.P.
- Mine or quarry

MISCELLANEOUS CULTURAL FEATURES

- Farmstead, house (omit in urban areas)
- Church
- School
- Indian mound (label) — Indian Mound
- Located object (label) — Tower
- Tank (label) — GAS
- Wells, oil or gas
- Windmill
- Kitchen midden

WATER FEATURES

DRAINAGE

- Perennial, double line
- Perennial, single line
- Intermittent
- Drainage end
- Canals or ditches
  - Double-line (label) — CANAL
  - Drainage and/or irrigation

LAKES, PONDS AND RESERVOIRS

- Perennial — water; w
- Intermittent — int; i

MISCELLANEOUS WATER FEATURES

- Marsh or swamp
- Spring
- Well, artesian
- Well, irrigation
- Wet spot

SPECIAL SYMBOLS FOR SOIL SURVEY

SOIL DELINEATIONS AND SYMBOLS — SvE 107

ESCARPMENTS

- Bedrock (points down slope)
- Other than bedrock (points down slope)

SHORT STEEP SLOPE

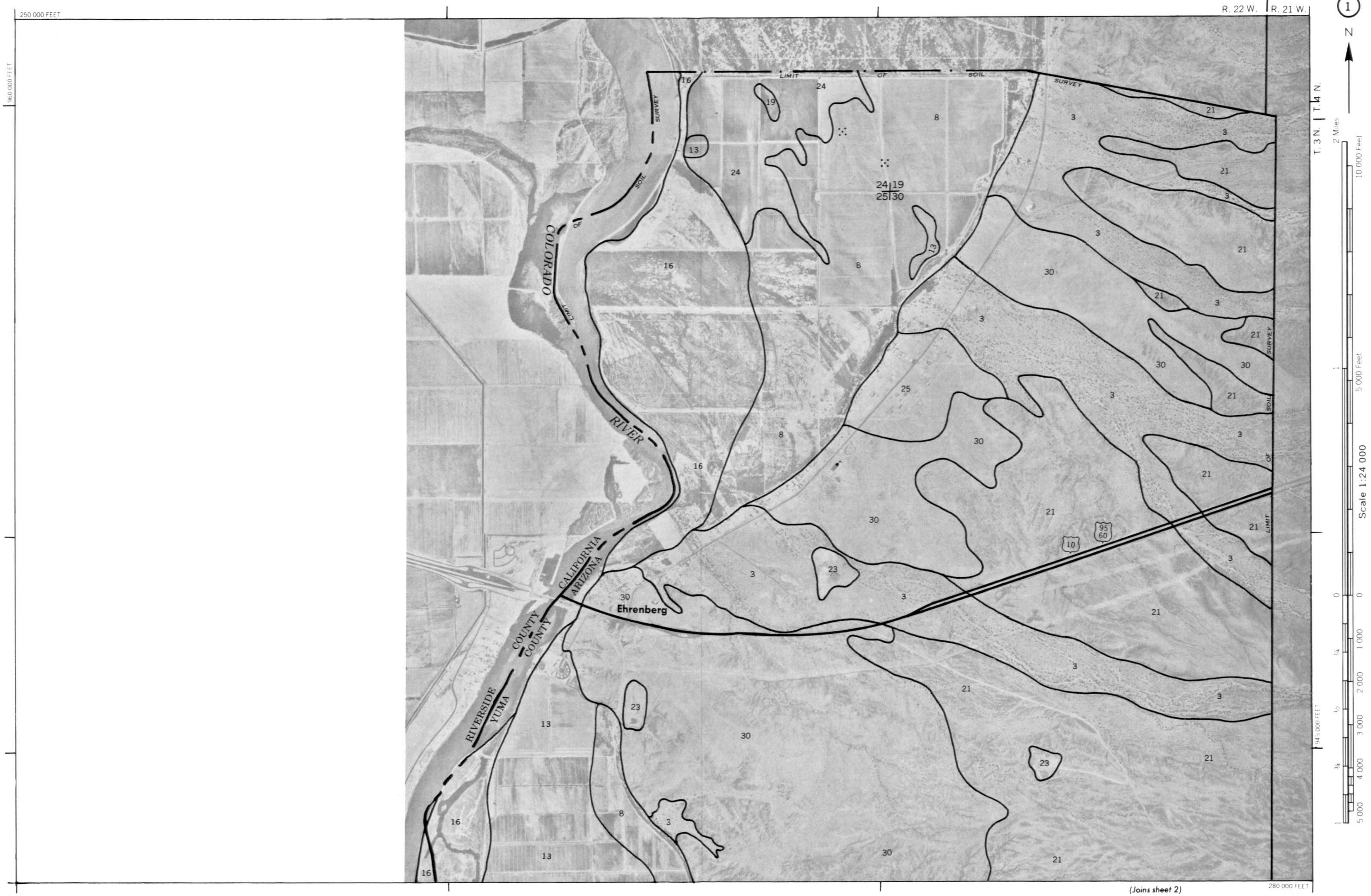
GULLY

DEPRESSION OR SINK

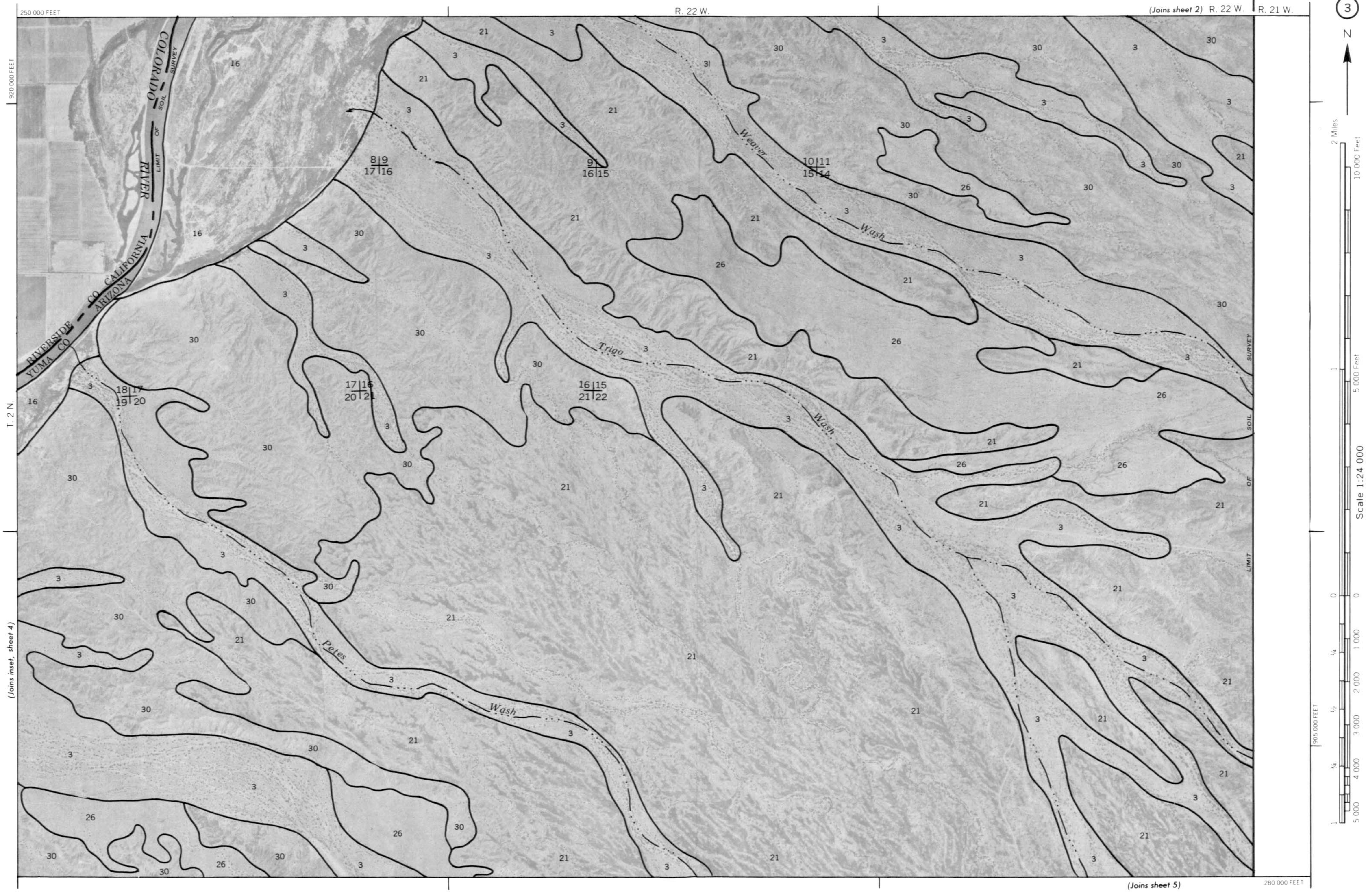
SOIL SAMPLE SITE (normally not shown) — S

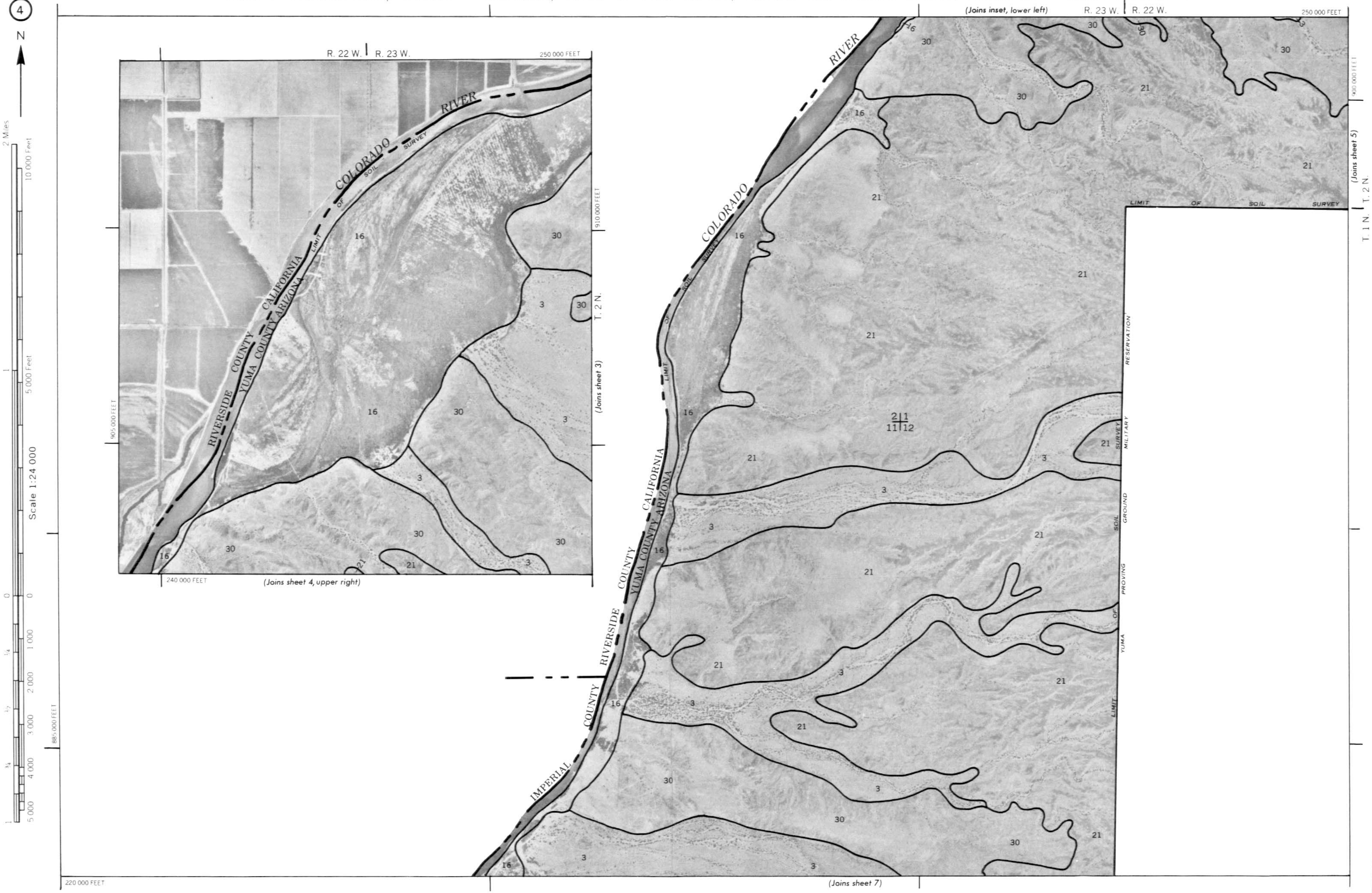
MISCELLANEOUS

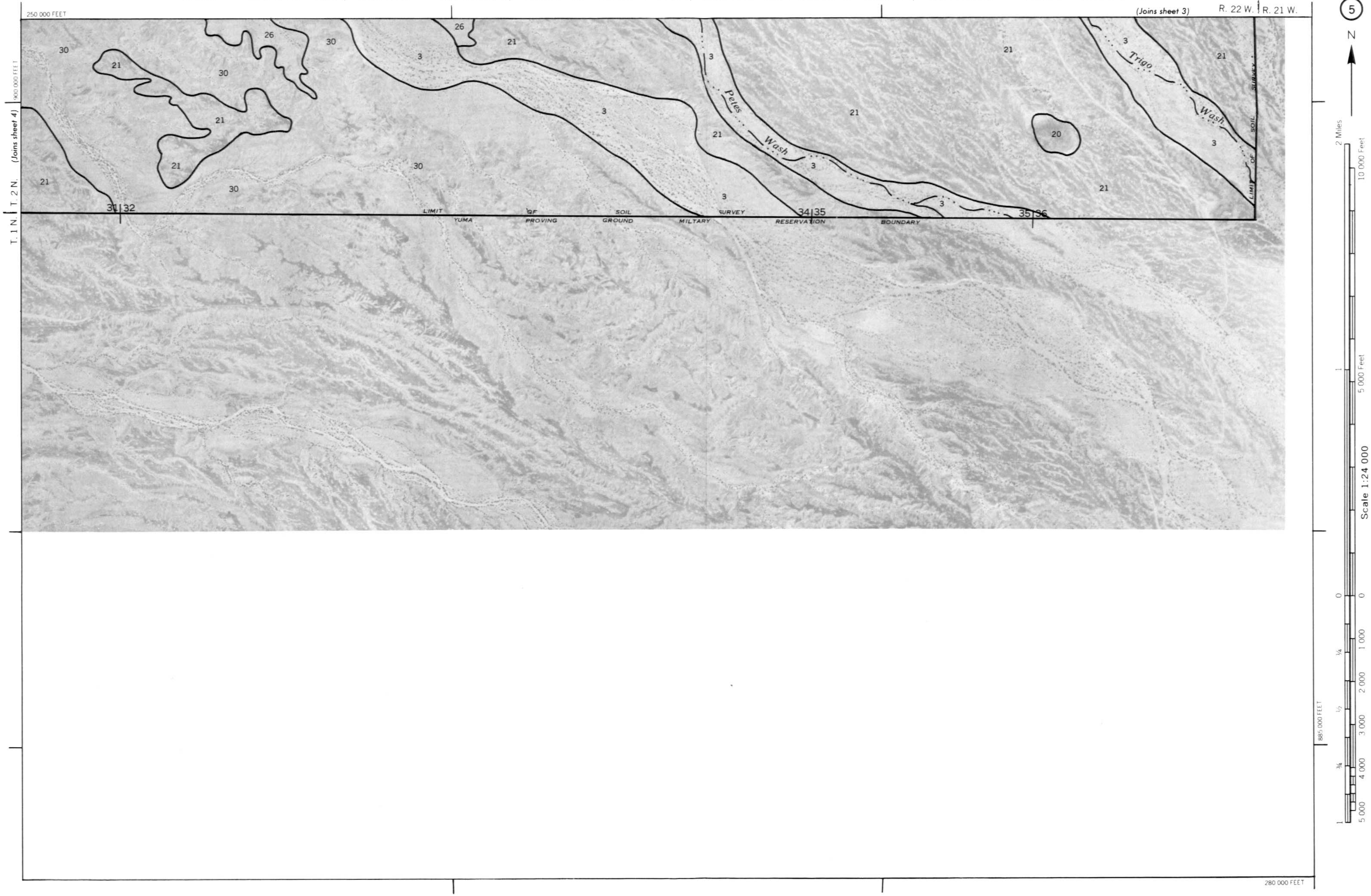
- Blowout
- Clay spot
- Gravelly spot
- Gumbo, slick or scabby spot (sodic)
- Dumps and other similar non soil areas
- Prominent hill or peak
- Rock outcrop (includes sandstone and shale)
- Saline spot
- Sandy spot
- Severely eroded spot
- Slide or slip (tips point upslope)
- Stony spot, very stony spot
- Filled sand ridges
- Unconforming sand between 12 to 40 inches
- Unconforming clay between 12 to 40 inches


1
N
250 000 FEET
960 000 FEET
R. 22 W.
R. 21 W.
T. 4 N.
T. 3 N.
LIMIT OF SOIL SURVEY
COLORADO RIVER
CALIFORNIA
ARIZONA
RIVERSIDE COUNTY
YUMA COUNTY
Ehrenberg
10
95
60
24 19
25 30
3
8
13
16
19
21
23
24
25
30
945 000 FEET
280 000 FEET
2 Miles
1
0
10 000 Feet
5 000 Feet
0
1000
2000
3000
4000
5000
¼
½
¾
Scale 1:24 000
(Joins sheet 2)


2
N
(Joins sheet 1)
(Joins sheet 3)
R. 22 W.
R. 22 W. | R. 21 W.
280 000 FEET
940 000 FEET
925 000 FEET
250 000 FEET
T. 3 N.
T. 2 N.
Scale 1:24 000
2 Miles
1
0
10 000 Feet
5 000 Feet
COLORADO
RIVER
Lake
Wash
Weaver
Wash
CALIFORNIA
ARIZONA
RIVERSIDE
COUNTY
YUMA
COUNTY
SURVEY
SOIL
OF
LIMIT
34 35
3 2
3
8
13
16
21
30

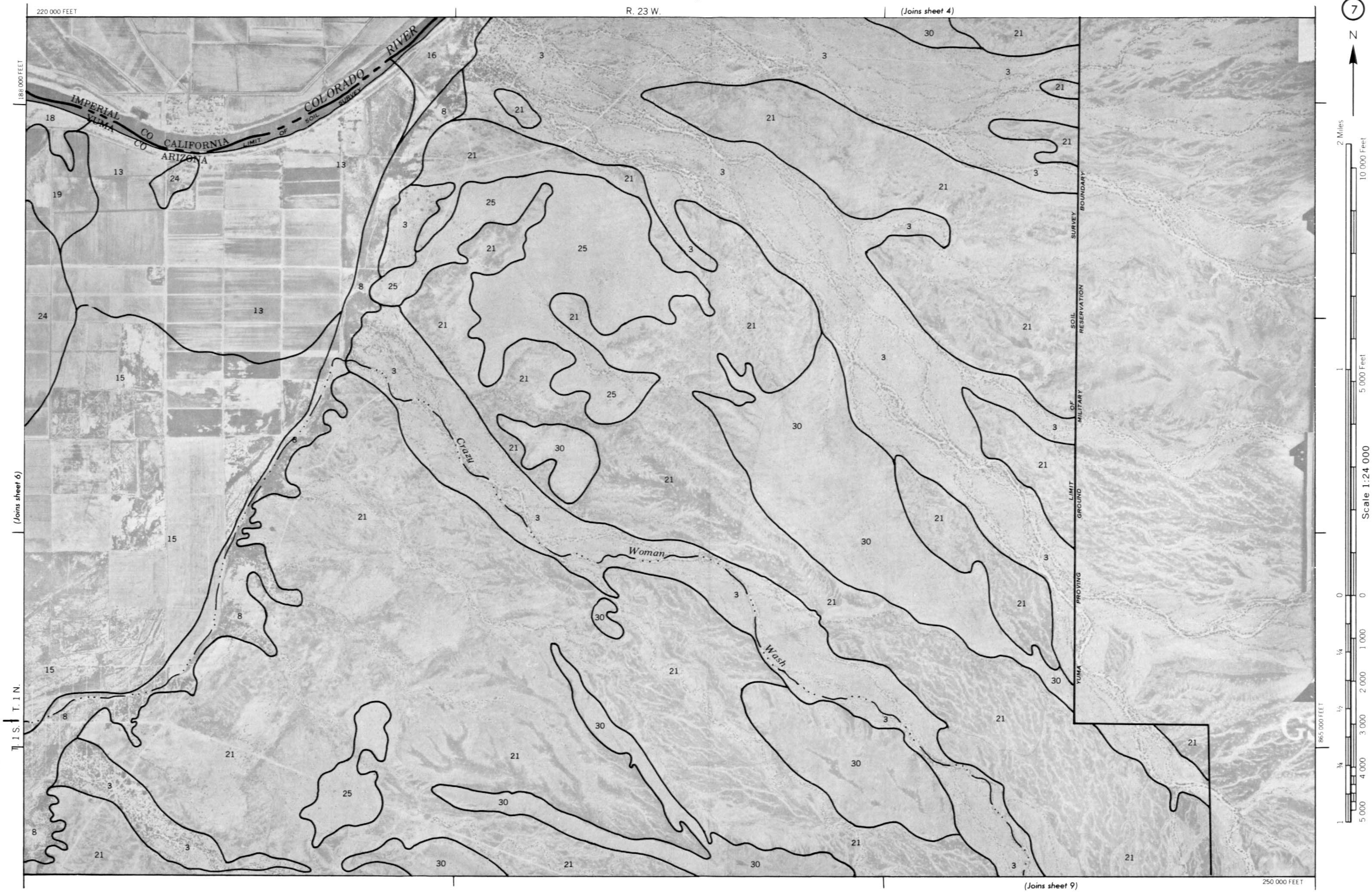

3
(Joins sheet 2)
R. 22 W.
R. 21 W.
250 000 FEET
920 000 FEET
T. 2 N.
(Joins inset, sheet 4)
(Joins sheet 5)
280 000 FEET
905 000 FEET
COLORADO
RIVER
LIMIT OF SOIL SURVEY
RIVERSIDE CO
YUMA CO
CALIFORNIA
ARIZONA
Weaver
Wash
Trigo
Wash
Petes
Wash
N
2 Miles
10 000 Feet
5 000 Feet
Scale 1:24 000

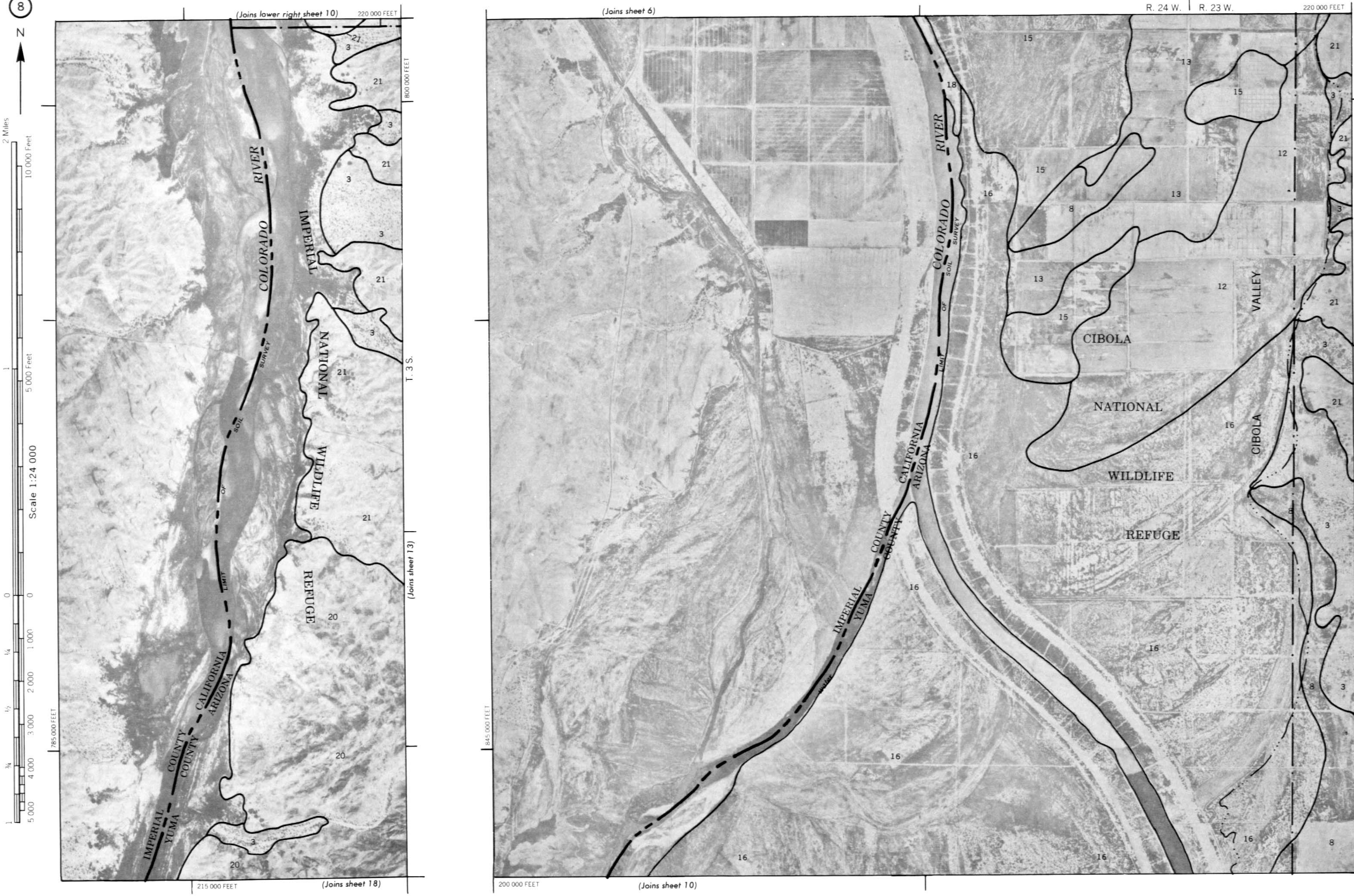

4
N
Scale 1:24 000
2 Miles
1
0
¼
½
¾
1
10 000 Feet
5 000 Feet
0
1 000
2 000
3 000
4 000
5 000
(Joins inset, lower left)
R. 23 W.
R. 22 W.
250 000 FEET
R. 22 W.
R. 23 W.
250 000 FEET
910 000 FEET
905 000 FEET
900 000 FEET
885 000 FEET
T. 2 N.
T. 1 N.
240 000 FEET
220 000 FEET
(Joins sheet 3)
(Joins sheet 4, upper right)
(Joins sheet 5)
(Joins sheet 7)
COLORADO
RIVER
RIVERSIDE
COUNTY
CALIFORNIA
YUMA COUNTY ARIZONA
IMPERIAL
LIMIT OF SOIL SURVEY
YUMA PROVING GROUND MILITARY RESERVATION
2 1
11 12
3
16
21
30


5
N
(Joins sheet 3)
R. 22 W. R. 21 W.
250 000 FEET
900 000 FEET
(Joins sheet 4)
T. 2 N.
T. 1 N.
30
21
26
3
20
Petes Wash
Trigo Wash
31 32
34 35
35 36
LIMIT OF SOIL SURVEY
YUMA PROVING GROUND MILITARY RESERVATION BOUNDARY
885 000 FEET
280 000 FEET
2 Miles
1
0
¼
½
¾
10 000 Feet
5 000 Feet
1 000
2 000
3 000
4 000
5 000
Scale 1:24 000

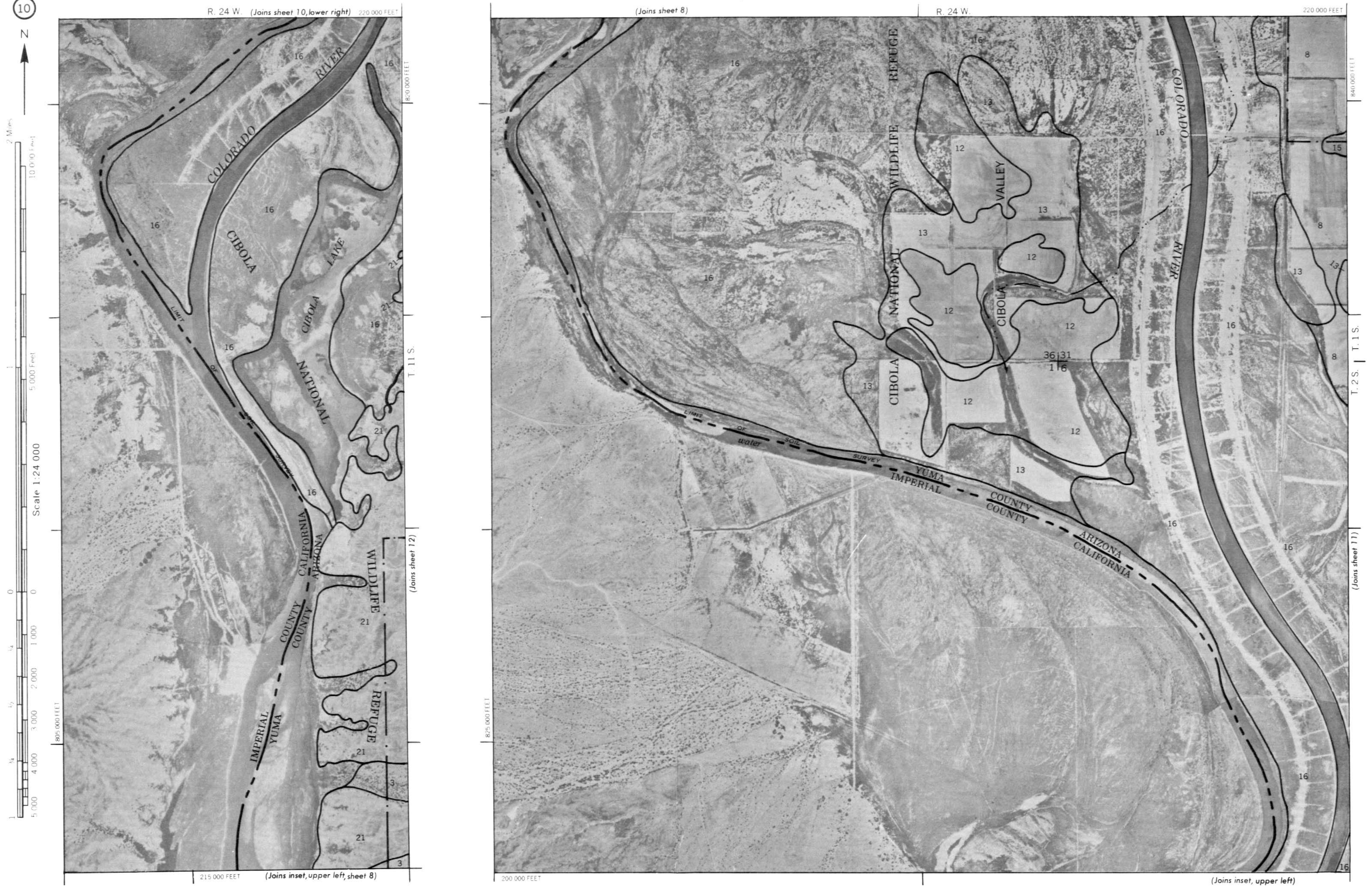

6
N
2 Miles
10 000 Feet
1
5 000 Feet
Scale 1:24 000
0
0
¼
1 000
2 000
½
3 000
¾
4 000
1
5 000
R. 22 E.
220 000 FEET
880 000 FEET
865 000 FEET
190 000 FEET
COLORADO
RIVER
LIMIT OF SOIL SURVEY
IMPERIAL COUNTY
CALIFORNIA
YUMA COUNTY ARIZONA
CIBOLA
VALLEY
CIBOLA NATIONAL WILDLIFE REFUGE
25 30
36 31
18
16
13
24
19
15
8
21
(Joins sheet 7)
T. 1 N.
T. 1 S.
(Joins sheet 8)
R. 24 E.
R. 23 E.

YUMA — WELLTON AREA, ARIZONA — CALIFORNIA, PARTS OF YUMA COUNTY, ARIZONA AND IMPERIAL COUNTY, CALIFORNIA — SHEET NUMBER 7

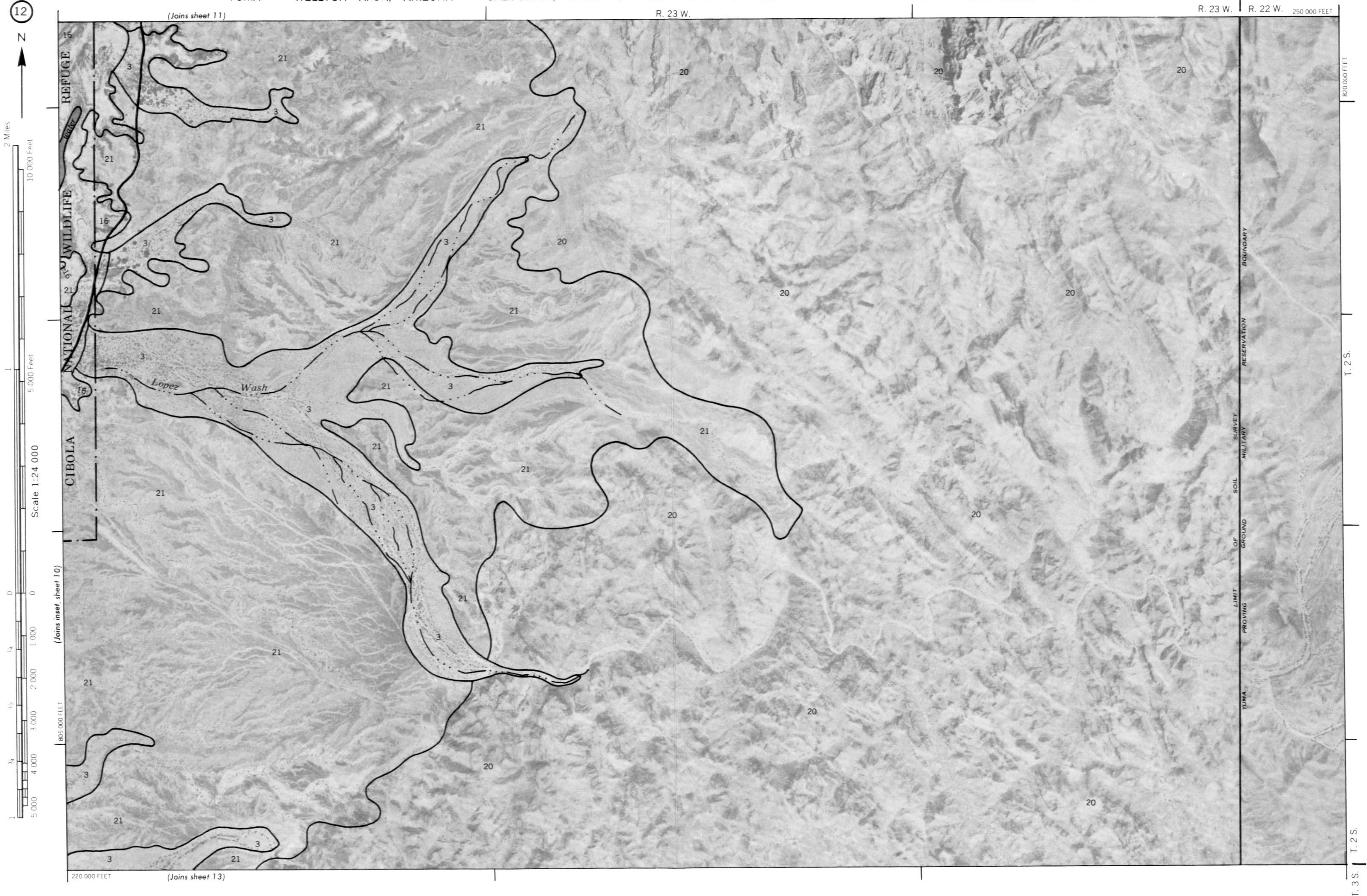



8
N
Scale 1:24 000
2 Miles
1
0
¼
½
¾
10 000 Feet
5 000 Feet
0
1 000
2 000
3 000
4 000
5 000
(Joins lower right sheet 10)
220 000 FEET
800 000 FEET
785 000 FEET
215 000 FEET
(Joins sheet 18)
(Joins sheet 13)
T. 3 S.
COLORADO RIVER
SOIL SURVEY LIMIT
IMPERIAL NATIONAL WILDLIFE REFUGE
CALIFORNIA
ARIZONA
IMPERIAL COUNTY
YUMA COUNTY
3
20
21
(Joins sheet 6)
R. 24 W.
R. 23 W.
220 000 FEET
860 000 FEET
845 000 FEET
200 000 FEET
(Joins sheet 10)
(Joins sheet 9)
T. 1 S.
CIBOLA VALLEY
CIBOLA NATIONAL WILDLIFE REFUGE
CIBOLA
8
12
13
15
16
18


220 000 FEET
R. 23 W.
(Joins sheet 7)
860 000 FEET
T. 1 S.
(Joins sheet 8)
7 8
18 17
Crazy
Woman
Wash
YUMA PROVING GROUND LIMIT OF MILITARY RESERVATION SOIL SURVEY BOUNDARY
845 000 FEET
(Joins sheet 11)
250 000 FEET
3
8
20
21
30
9
N
Scale 1:24 000
2 Miles
1
0
10 000 Feet
5 000 Feet

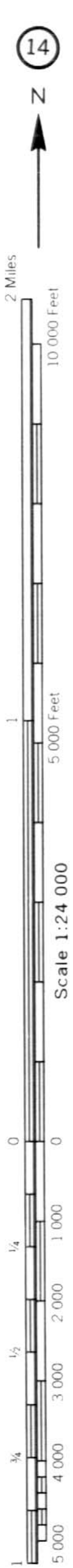

10
N
Scale 1:24 000
R. 24 W.
(Joins sheet 10, lower right)
(Joins sheet 8)
(Joins sheet 12)
(Joins sheet 11)
(Joins inset, upper left, sheet 8)
(Joins inset, upper left)
T. 1 S.
T. 2 S.
215 000 FEET
200 000 FEET
220 000 FEET
805 000 FEET
825 000 FEET
840 000 FEET
COLORADO RIVER
CIBOLA LAKE
CIBOLA NATIONAL WILDLIFE REFUGE
CIBOLA VALLEY
LIMIT OF SOIL SURVEY
water
CALIFORNIA
ARIZONA
YUMA COUNTY
IMPERIAL COUNTY
36 31
1 6

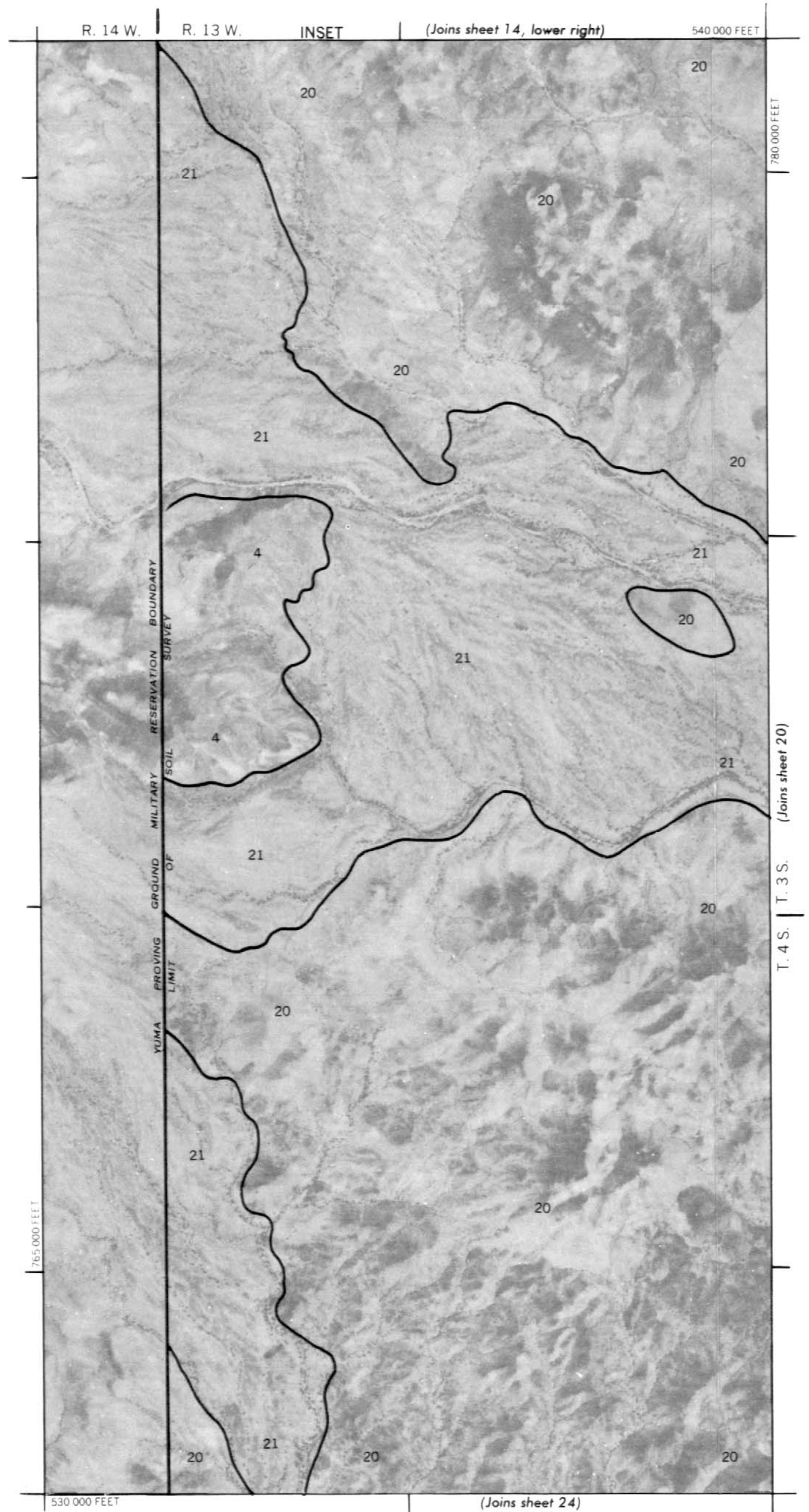

220 000 FEET
R. 23 W.
(Joins sheet 9)
R. 23 W.
R. 22 W.
11
N
840 000 FEET
T. 1 S.
T. 2 S.
(Joins sheet 10)
REFUGE
WILDLIFE
NATIONAL
CIBOLA
COLORADO RIVER
YUMA PROVING GROUND OF MILITARY SOIL SURVEY RESERVATION BOUNDARY
LIMIT
825 000 FEET
(Joins sheet 12)
250 000 FEET
Scale 1:24 000
2 Miles
10 000 Feet
5 000 Feet
1
0
1/4
1/2
3/4
1 000
2 000
3 000
4 000
5 000
8
21
3
15
13
16
20

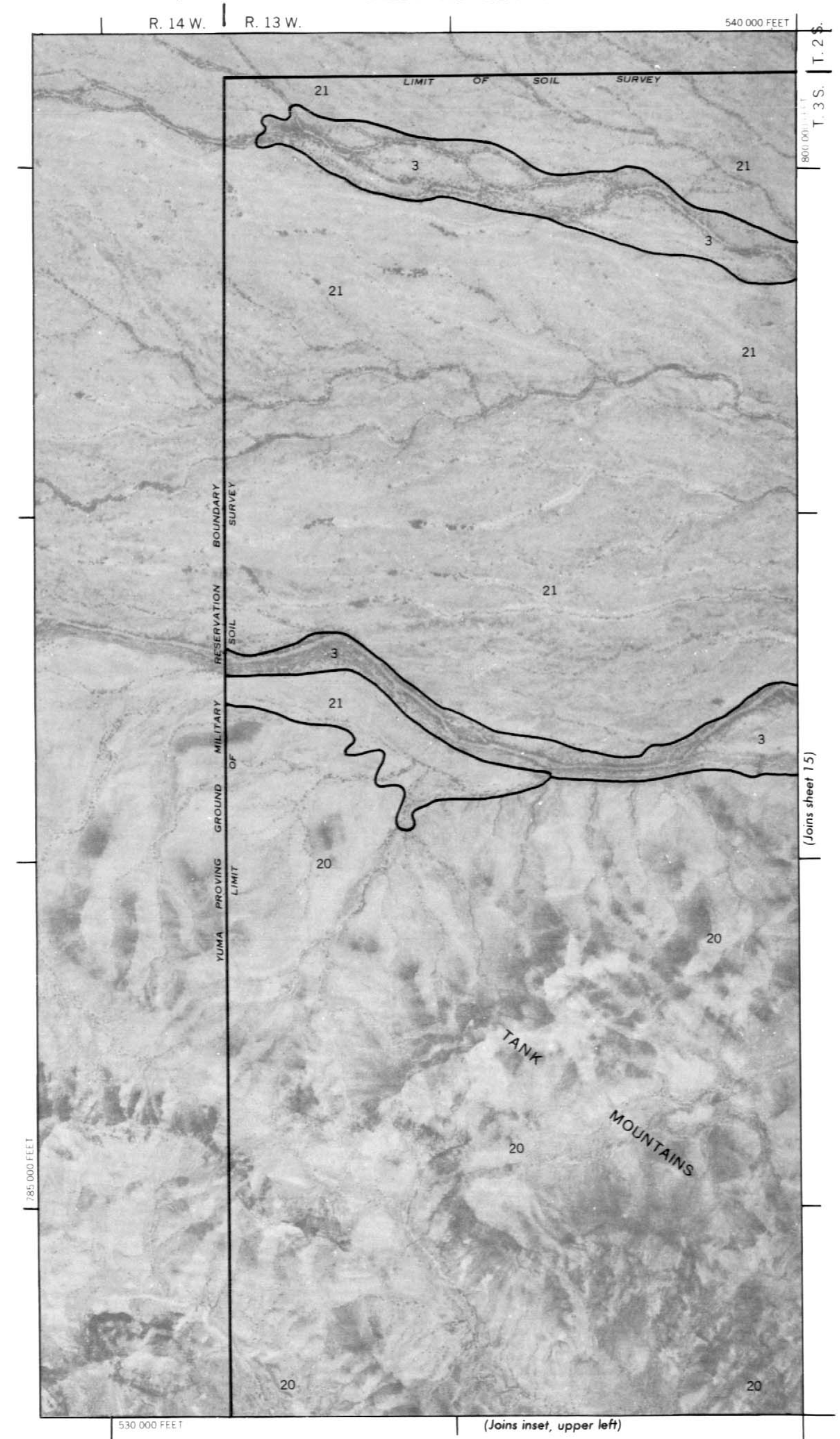

12
N
(Joins sheet 11)
R. 23 W.
R. 23 W.
R. 22 W.
250 000 FEET
820 000 FEET
T. 2 S.
T. 2 S.
T. 3 S.
CIBOLA NATIONAL WILDLIFE REFUGE
Water
Lopez Wash
YUMA PROVING GROUND LIMIT OF SOIL SURVEY MILITARY RESERVATION BOUNDARY
(Joins inset, sheet 10)
805 000 FEET
220 000 FEET
(Joins sheet 13)
Scale 1:24 000
2 Miles
1
0
10 000 Feet
5 000 Feet
0
1 000
2 000
3 000
4 000
5 000
3
16
20
21

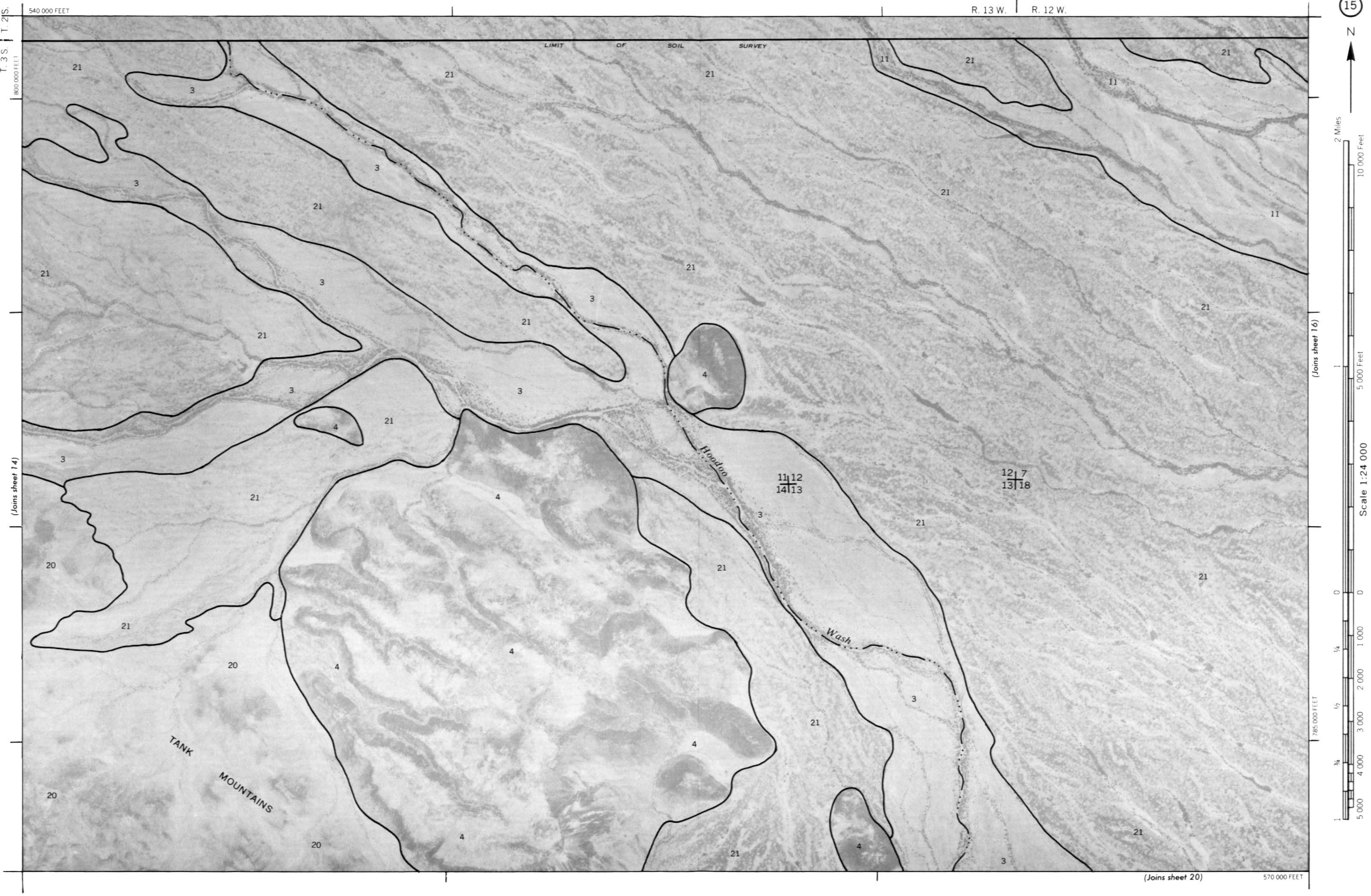
YUMA — WELLTON AREA, ARIZONA — CALIFORNIA, PARTS OF YUMA COUNTY, ARIZONA AND IMPERIAL COUNTY, CALIFORNIA — SHEET NUMBER 13

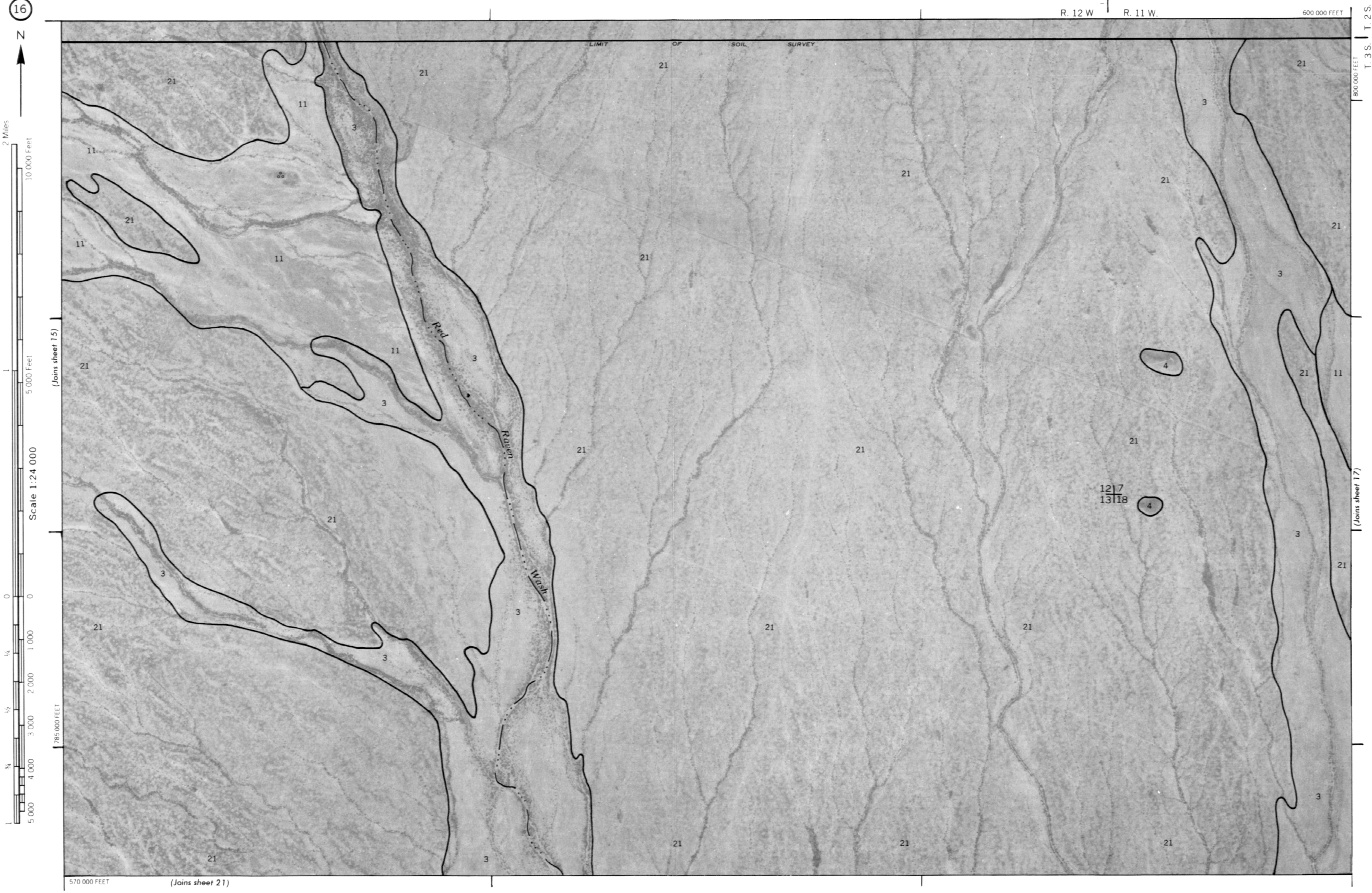
YUMA — WELLTON AREA, ARIZONA — CALIFORNIA, PARTS OF YUMA COUNTY, ARIZONA AND IMPERIAL COUNTY, CALIFORNIA — SHEET NUMBER 14

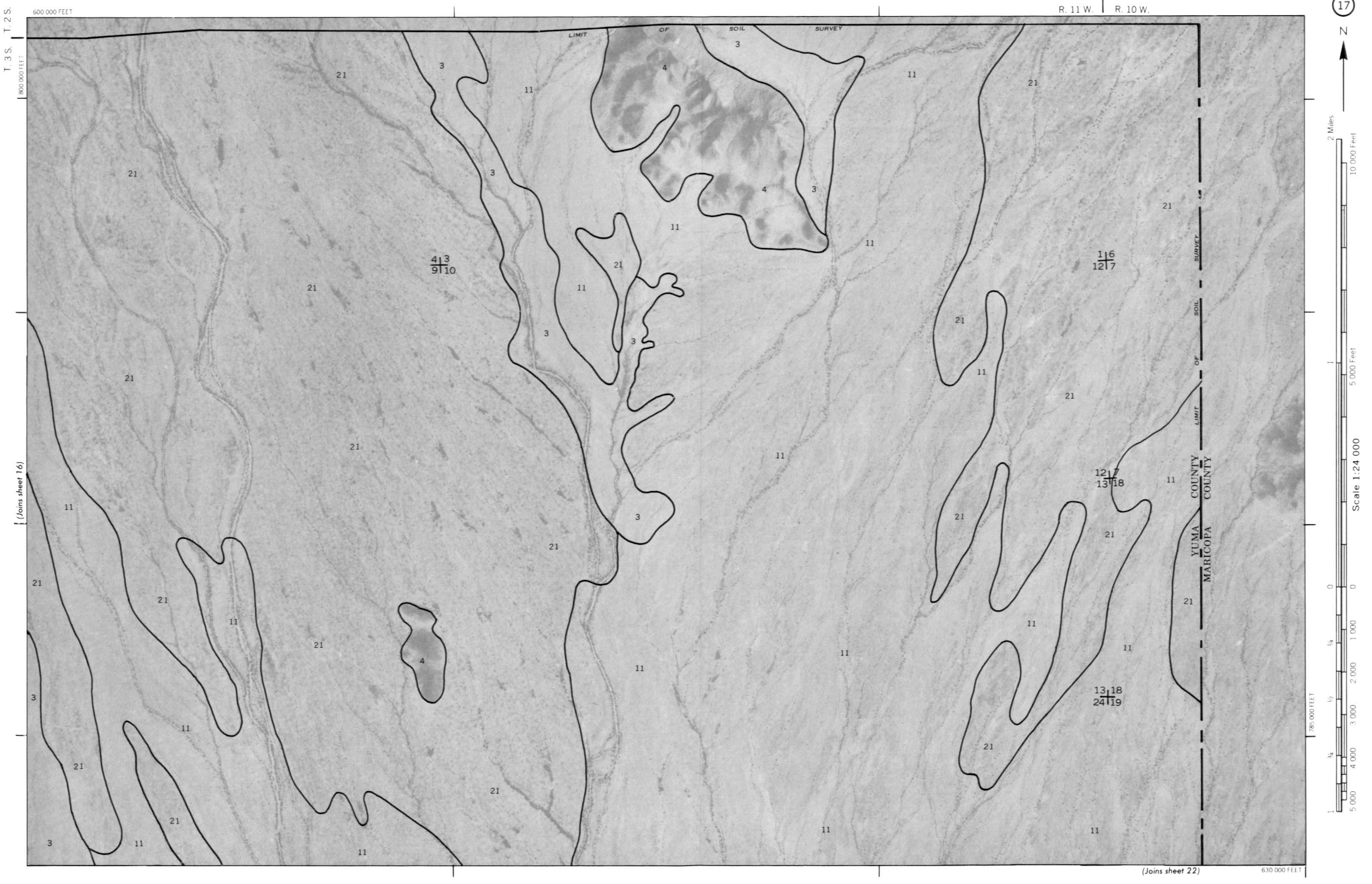


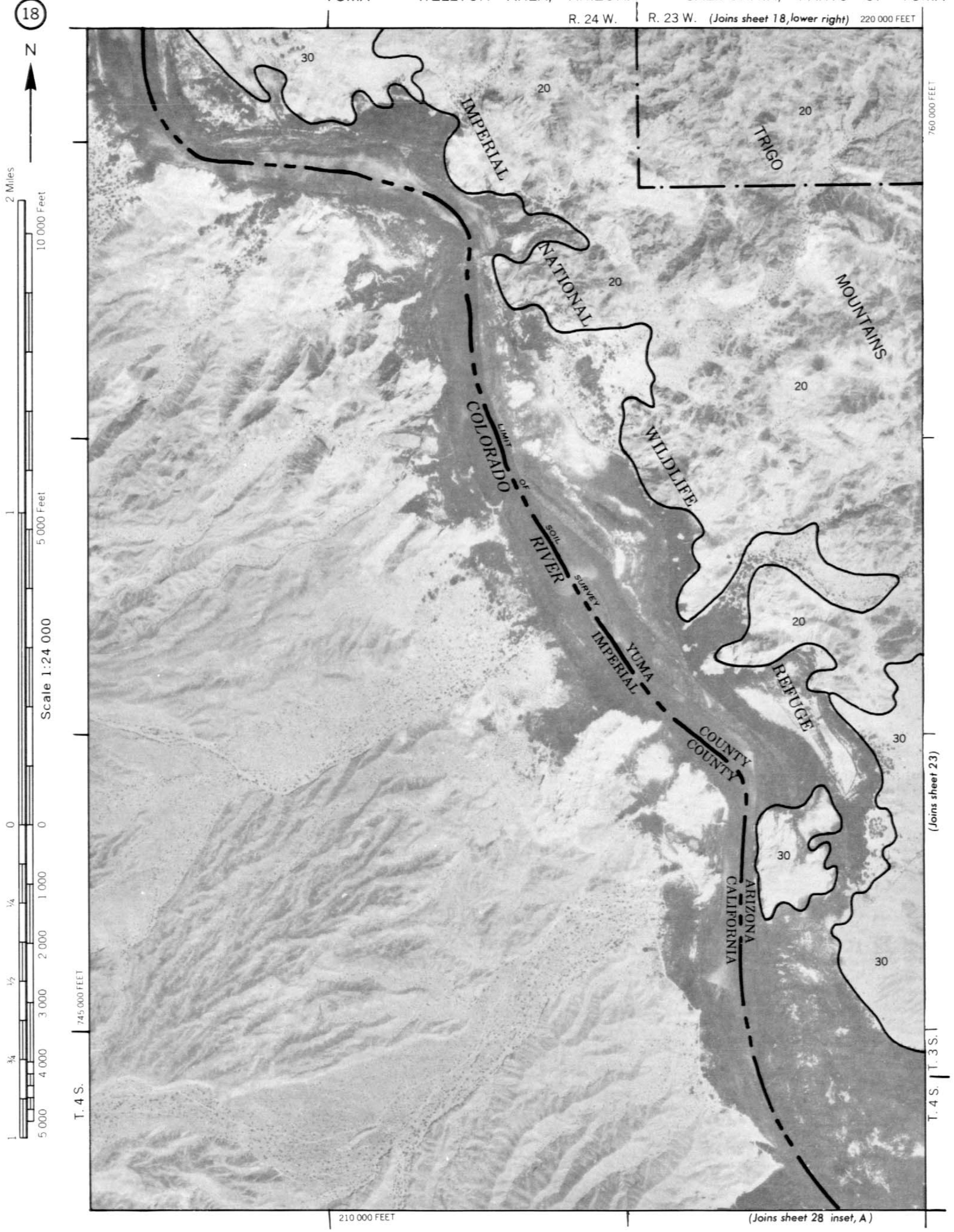


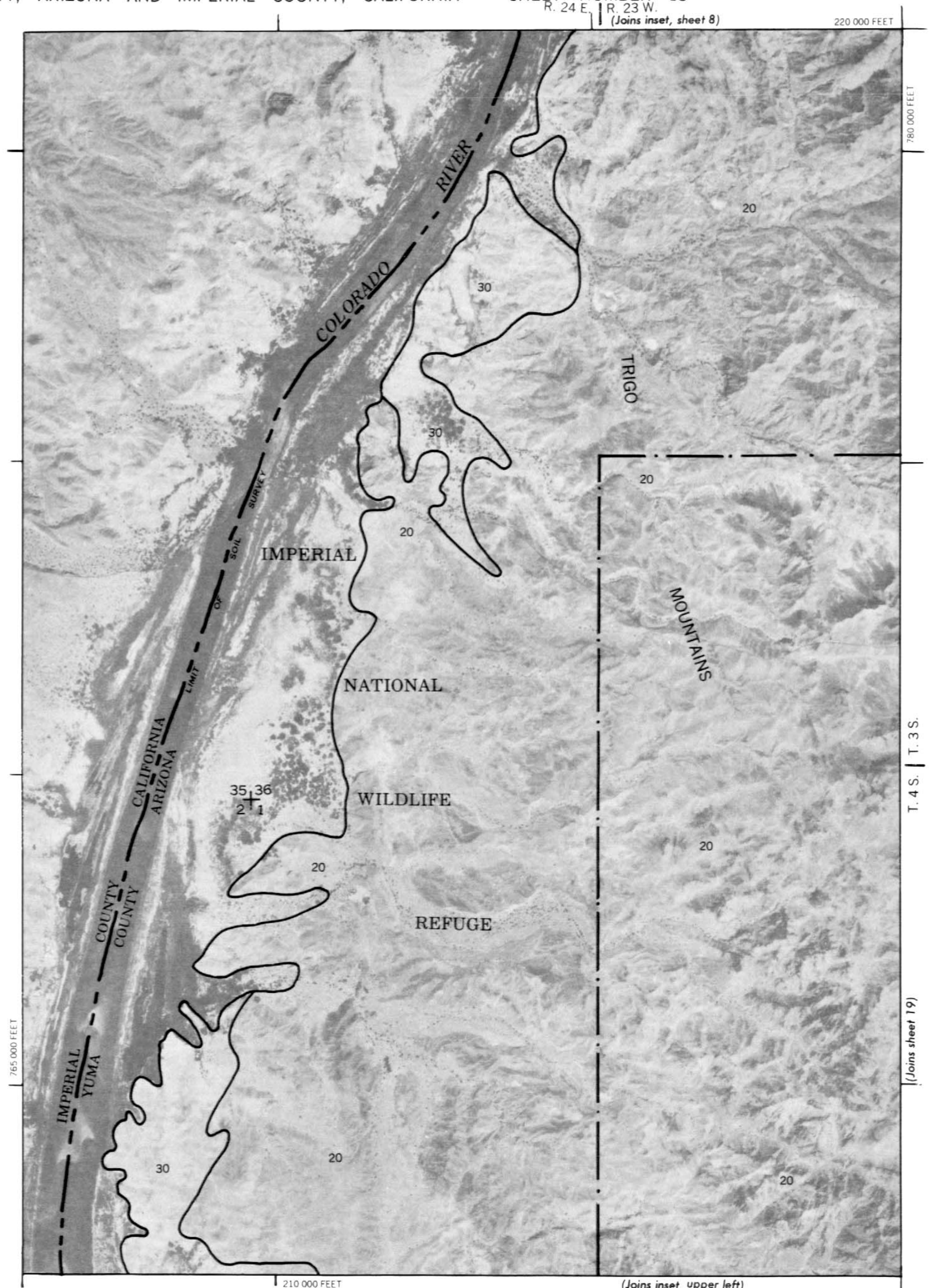


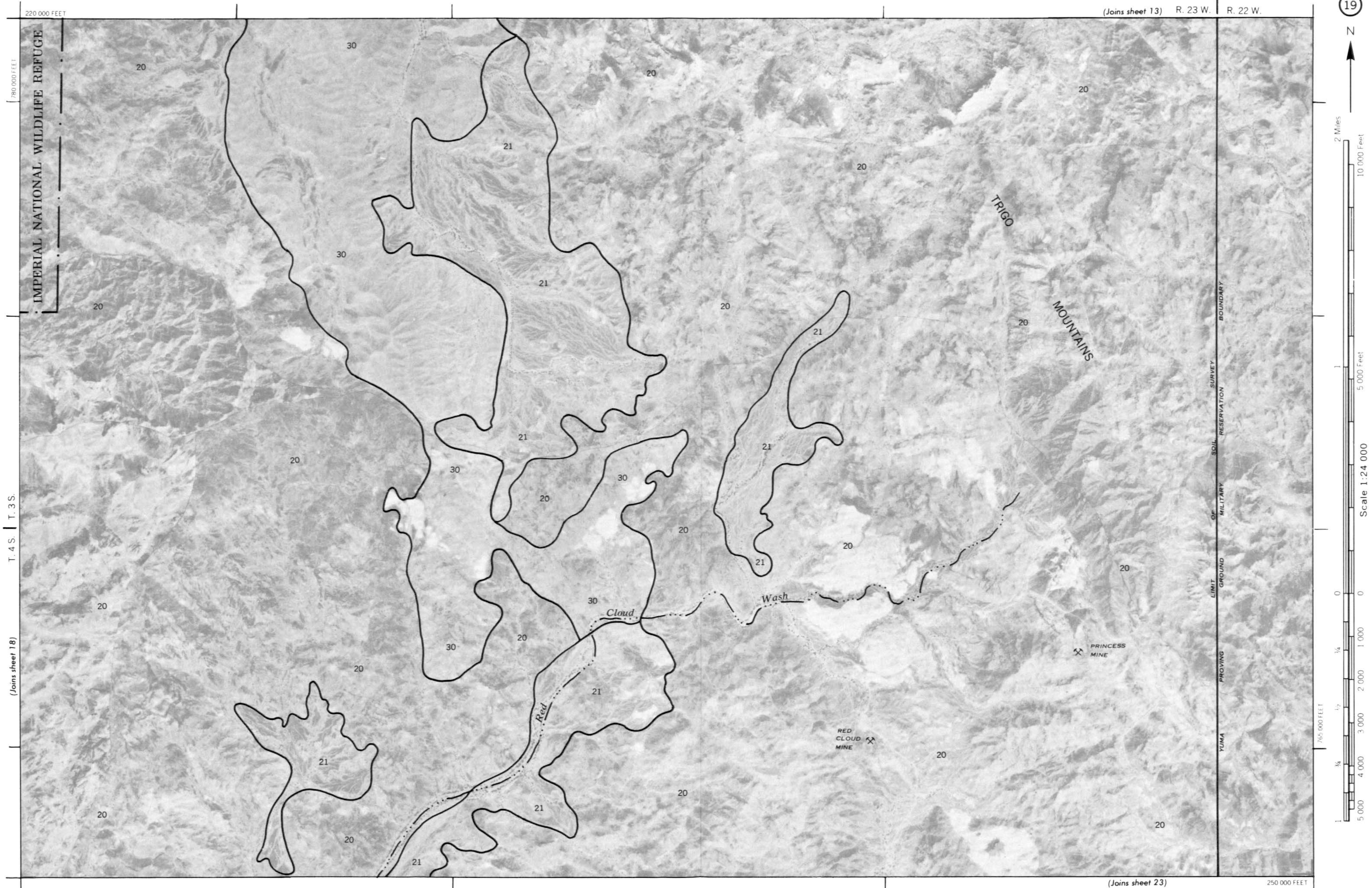

15
N
540 000 FEET
R. 13 W.
R. 12 W.
T. 2 S.
T. 3 S.
800 000 FEET
LIMIT OF SOIL SURVEY
Hoodoo Wash
TANK MOUNTAINS
11 12
14 13
12 7
13 18
(Joins sheet 16)
(Joins sheet 14)
(Joins sheet 20)
570 000 FEET
785 000 FEET
2 Miles
1
¾
½
¼
0
10 000 Feet
5 000 Feet
5 000
4 000
3 000
2 000
1 000
Scale 1:24 000

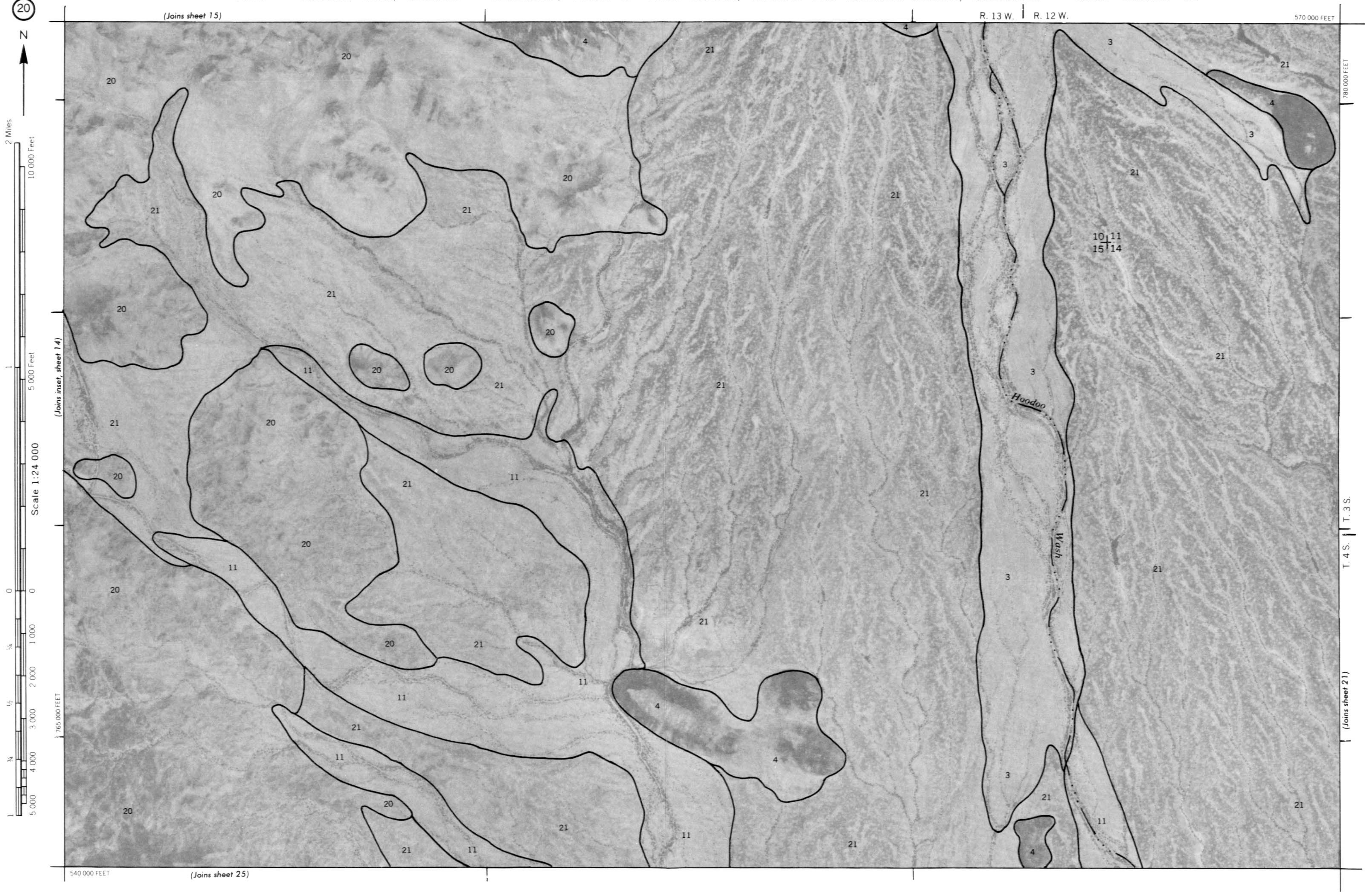

16
N
Scale 1:24 000
2 Miles
10 000 Feet
5 000 Feet
R. 12 W
R. 11 W.
600 000 FEET
T. 2 S.
T. 3 S.
800 000 FEET
785 000 FEET
570 000 FEET
LIMIT OF SOIL SURVEY
Red Raven Wash
(Joins sheet 15)
(Joins sheet 17)
(Joins sheet 21)
12|7
13|18
21
11
3
4


17
N
R. 11 W.
R. 10 W.
T. 2 S.
T. 3 S.
600 000 FEET
800 000 FEET
785 000 FEET
630 000 FEET
LIMIT OF SOIL SURVEY
(Joins sheet 16)
(Joins sheet 22)
YUMA COUNTY
MARICOPA COUNTY
Scale 1:24 000
2 Miles
1
0
10 000 Feet
5 000 Feet
1 000
2 000
3 000
4 000
5 000
3
4
11
21

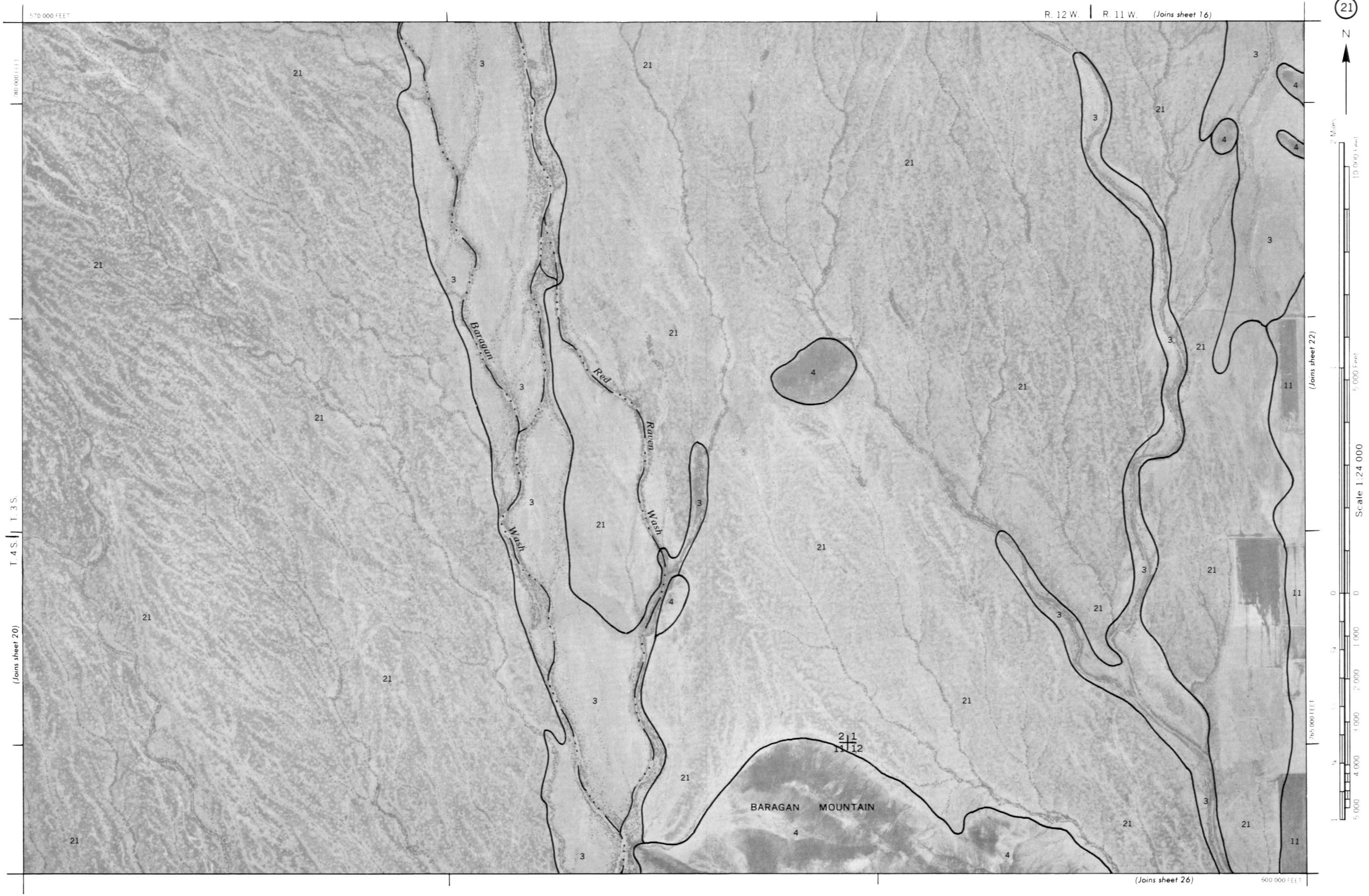

18
N
Scale 1:24 000
2 Miles
1
0
¼
½
¾
1
10 000 Feet
5 000 Feet
0
1 000
2 000
3 000
4 000
5 000
R. 24 W.
R. 23 W.
(Joins sheet 18, lower right)
220 000 FEET
760 000 FEET
745 000 FEET
210 000 FEET
(Joins sheet 28 inset, A)
(Joins sheet 23)
T. 3 S.
T. 4 S.
IMPERIAL
NATIONAL
WILDLIFE
REFUGE
TRIGO
MOUNTAINS
COLORADO
RIVER
LIMIT OF SOIL SURVEY
YUMA
IMPERIAL
COUNTY
COUNTY
ARIZONA
CALIFORNIA
20
30


R. 24 E.
R. 23 W.
(Joins inset, sheet 8)
220 000 FEET
780 000 FEET
765 000 FEET
210 000 FEET
(Joins inset, upper left)
(Joins sheet 19)
T. 3 S.
T. 4 S.
COLORADO
RIVER
LIMIT OF SOIL SURVEY
IMPERIAL
NATIONAL
WILDLIFE
REFUGE
TRIGO
MOUNTAINS
CALIFORNIA
ARIZONA
COUNTY
COUNTY
IMPERIAL
YUMA
35
36
2
1
20
30

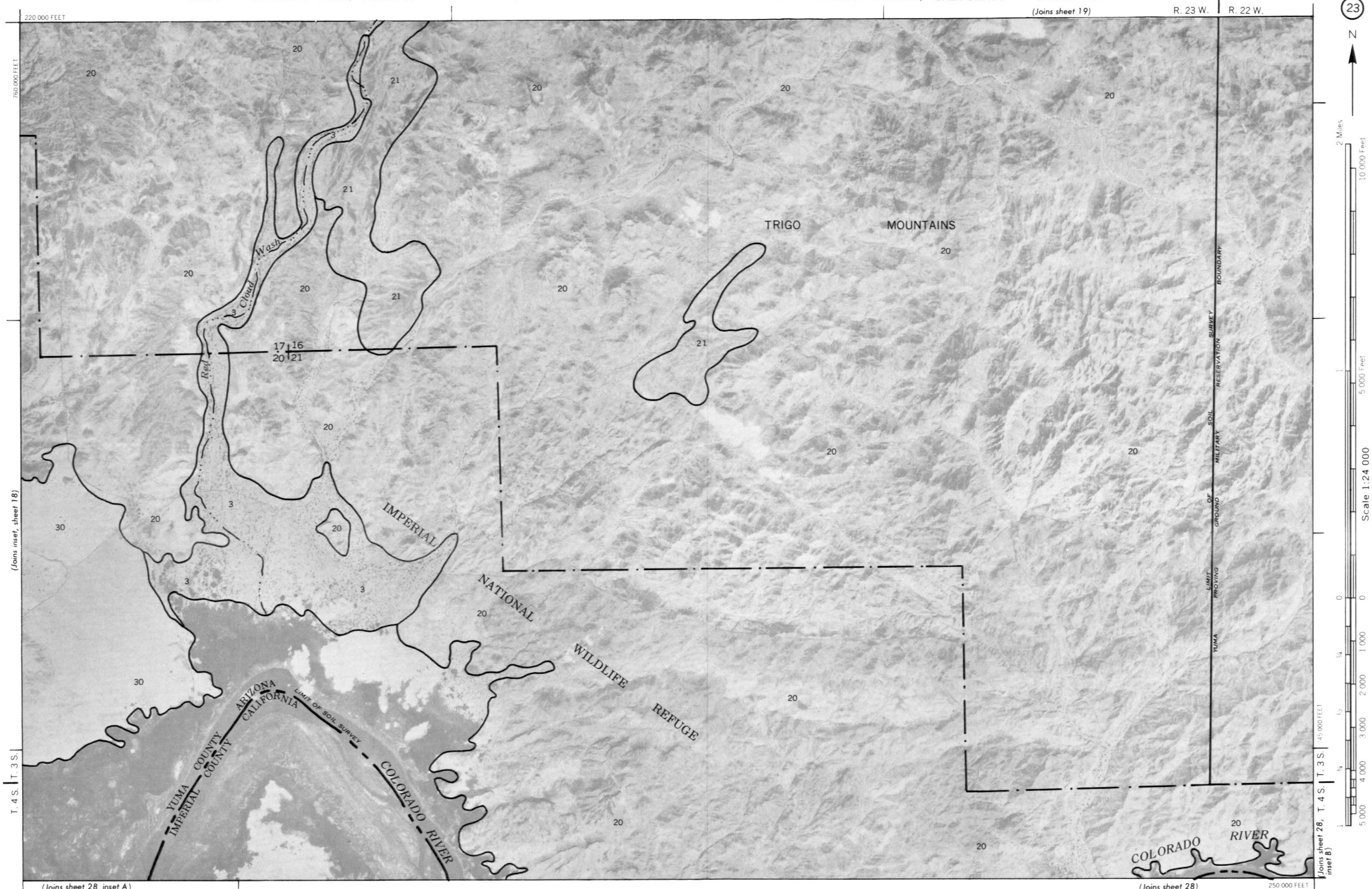

19
N
(Joins sheet 13)
R. 23 W.
R. 22 W.
220 000 FEET
780 000 FEET
IMPERIAL NATIONAL WILDLIFE REFUGE
TRIGO
MOUNTAINS
Cloud
Wash
Red
PRINCESS MINE
RED CLOUD MINE
YUMA PROVING GROUND LIMIT OF SOIL SURVEY MILITARY RESERVATION BOUNDARY
T. 3 S.
T. 4 S.
(Joins sheet 18)
(Joins sheet 23)
765 000 FEET
250 000 FEET
20
21
30
2 Miles
10 000 Feet
5 000 Feet
Scale 1:24 000
0
1
1/4
1/2
3/4
1 000
2 000
3 000
4 000
5 000

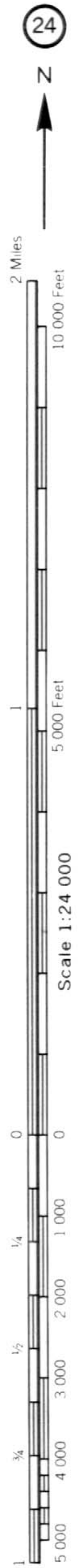

20
N
2 Miles
10 000 Feet
5 000 Feet
Scale 1:24 000
(Joins sheet 15)
R. 13 W.
R. 12 W.
570 000 FEET
780 000 FEET
(Joins inset, sheet 14)
(Joins sheet 21)
T. 3 S.
T. 4 S.
765 000 FEET
540 000 FEET
(Joins sheet 25)
Hoodoo
Wash
10 11
15 14

YUMA — WELLTON AREA, ARIZONA — CALIFORNIA, PARTS OF YUMA COUNTY, ARIZONA AND IMPERIAL COUNTY, CALIFORNIA — SHEET NUMBER 21

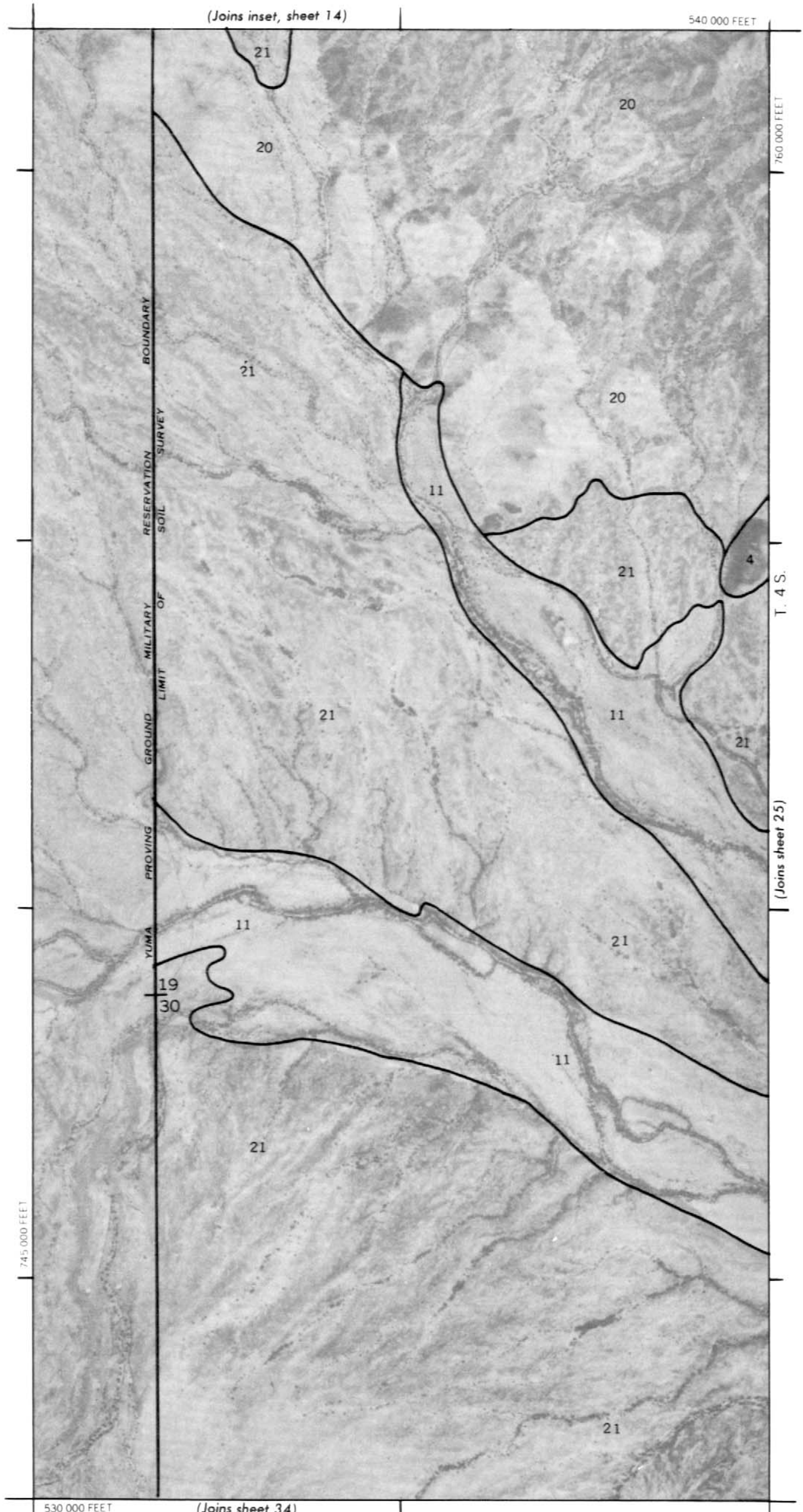


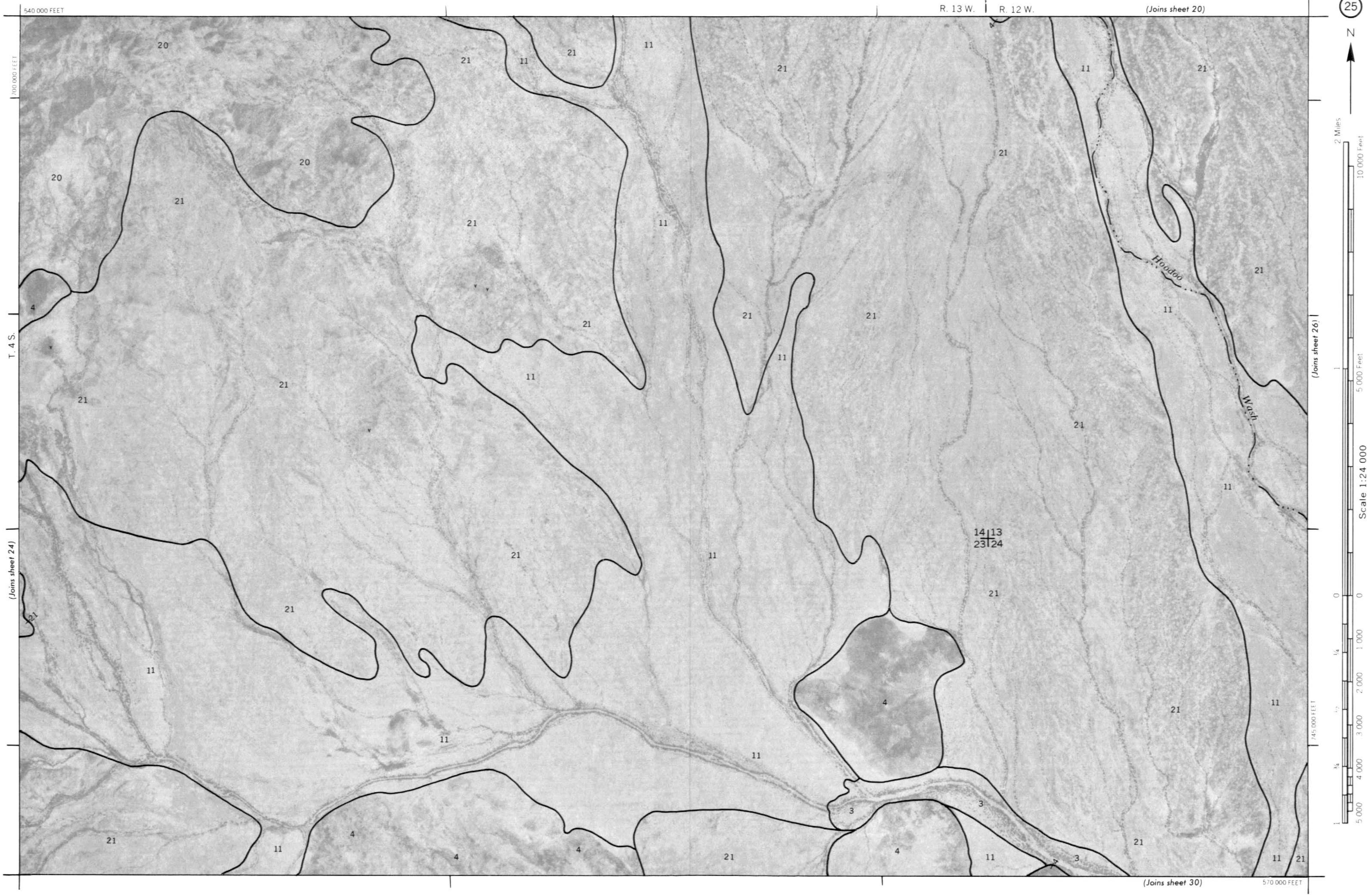

N
(Joins sheet 17)
R. 11 W.
R. 10 W.
630 000 FEET
780 000 FEET
TURTLE BACK
MOUNTAIN
(Joins sheet 21)
Scale 1:24 000
2 Miles
10 000 Feet
5 000 Feet
765 000 FEET
T. 3 S.
T. 4 S.
LIMIT OF SOIL SURVEY
YUMA COUNTY
MARICOPA COUNTY
600 000 FEET
(Joins sheet 27)


23
220 000 FEET
(Joins sheet 19)
R. 23 W.
R. 22 W.
760 000 FEET
N
TRIGO
MOUNTAINS
Red
Cloud
Wash
IMPERIAL
NATIONAL
WILDLIFE
REFUGE
17 16
20 21
20
21
3
30
(Joins inset, sheet 18)
YUMA MILITARY PROVING GROUND RESERVATION BOUNDARY
LIMIT OF SOIL SURVEY
ARIZONA
CALIFORNIA
YUMA COUNTY
IMPERIAL COUNTY
COLORADO RIVER
T. 3 S.
T. 4 S.
(Joins sheet 28, inset A)
(Joins sheet 28)
(Joins sheet 28, inset B)
250 000 FEET
Scale 1:24 000
2 Miles
10 000 Feet
5 000 Feet
1
0
1/4
1/2
3/4
1 000
2 000
3 000
4 000
5 000


24
N
2 Miles
10 000 Feet
1
5 000 Feet
Scale 1:24 000
0
0
1000
2000
3000
4000
5000
1/4
1/2
3/4
1
5 000

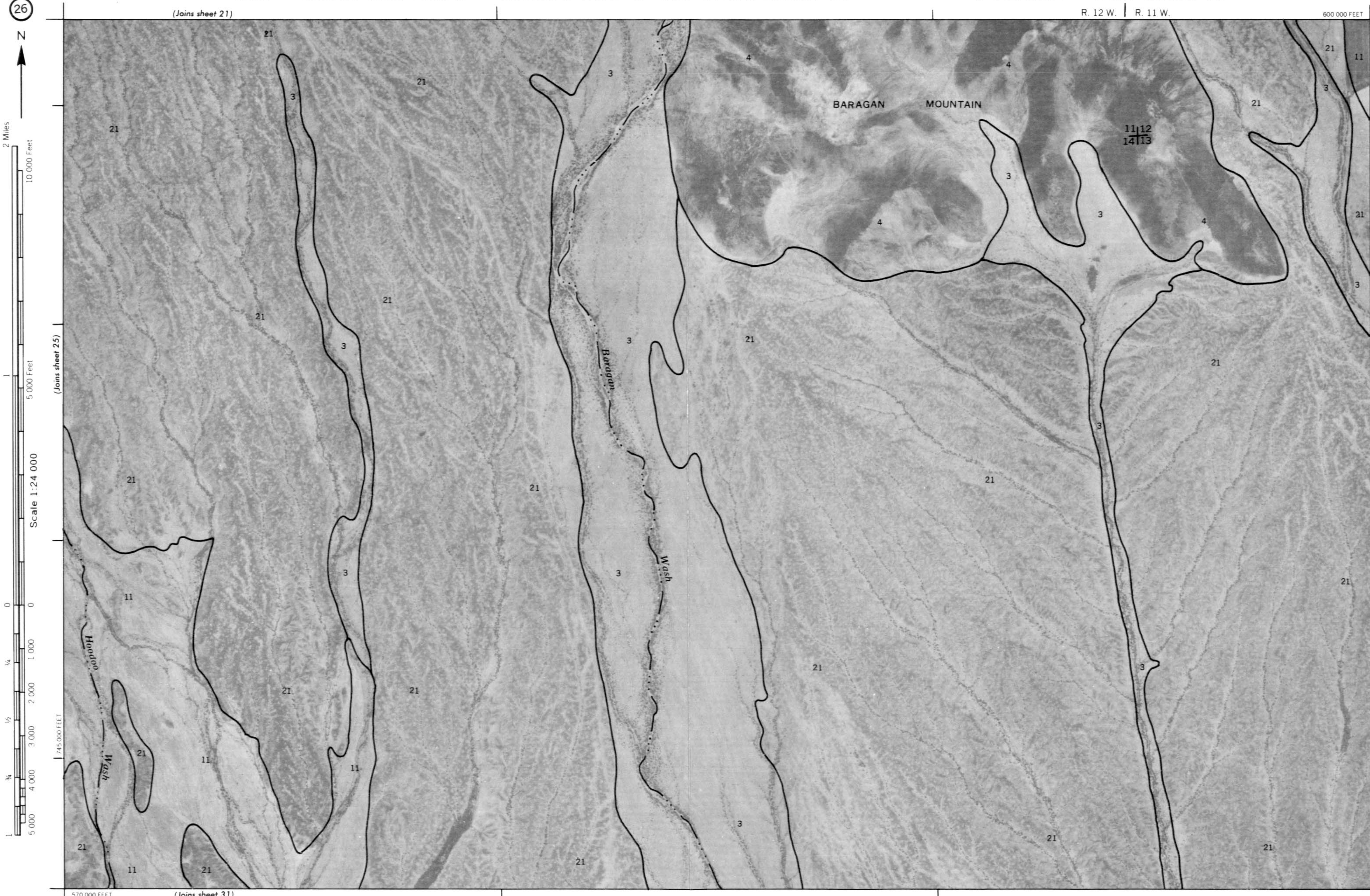

INSET A
R. 21 E.
R. 22 E.
210 000 FEET
640 000 FEET
625 000 FEET
200 000 FEET
(Joins sheet 73)
(Joins sheet 62)
T. 16 S.
T. 8 S.
LIMIT OF SOIL SURVEY
SOUTHERN PACIFIC
80
8
IMPERIAL COUNTY CALIFORNIA
YUMA COUNTY ARIZONA
COLORADO RIVER
BAJA CALIFORNIA
MEXICO
30
15
13
16
25
5
12
8
10
17


(Joins inset, sheet 14)
540 000 FEET
760 000 FEET
745 000 FEET
530 000 FEET
(Joins sheet 34)
(Joins sheet 25)
T. 4 S.
YUMA PROVING GROUND MILITARY RESERVATION BOUNDARY
LIMIT OF SOIL SURVEY
21
20
11
4
19
30

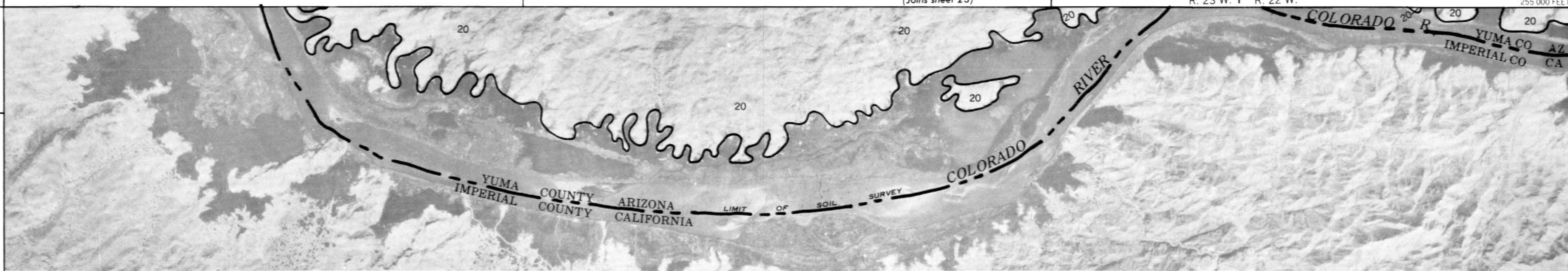


540 000 FEET
700 000 FEET
R. 13 W.
R. 12 W.
(Joins sheet 20)
25
N
T. 4 S.
(Joins sheet 24)
(Joins sheet 26)
(Joins sheet 30)
570 000 FEET
745 000 FEET
Hoodoo
Wash
14 13
23 24
20
21
11
4
3
2 Miles
1
0
10 000 Feet
5 000 Feet
0
1 000
2 000
3 000
4 000
5 000
Scale 1:24 000

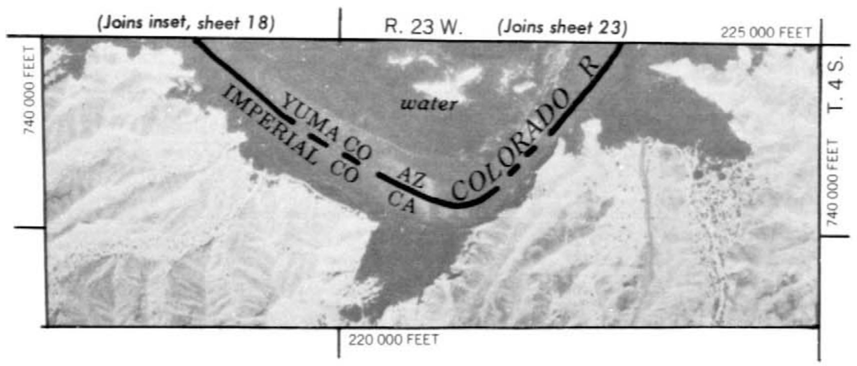
YUMA — WELLTON AREA, ARIZONA — CALIFORNIA, PARTS OF YUMA COUNTY, ARIZONA AND IMPERIAL COUNTY, CALIFORNIA — SHEET NUMBER 26



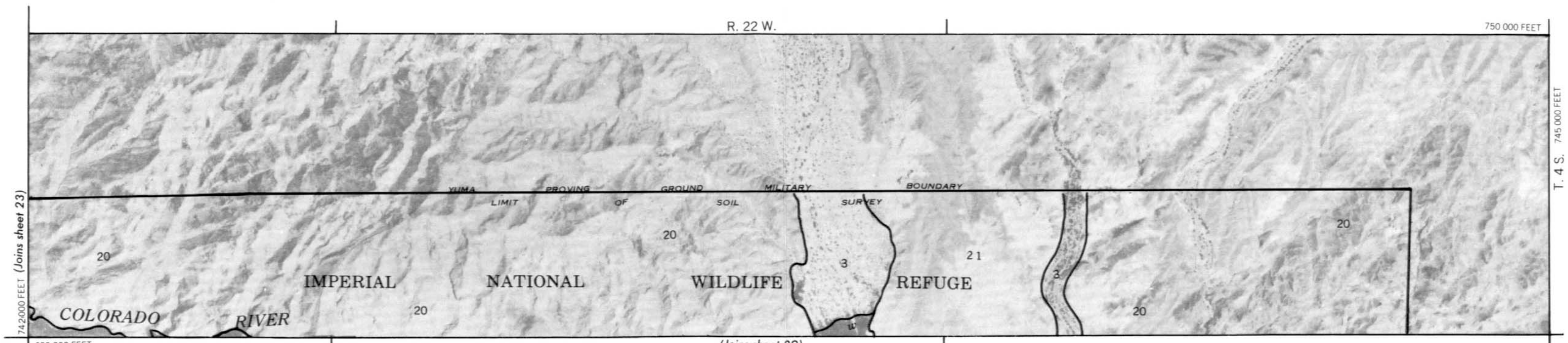

27
600 000 FEET
760 000 FEET
(Joins sheet 22)
R. 11 W.
R. 10 W.
N
T. 4 S.
(Joins sheet 26)
(Joins sheet 32)
630 000 FEET
745 000 FEET
11
21
3
11 12
14 13
14 13
23 24
24 19
25 30
SURVEY
SOIL
OF
LIMIT
YUMA COUNTY
MARICOPA COUNTY
Scale 1:24 000
2 Miles
1
0
¼
½
¾
1
10 000 Feet
5 000 Feet
0
1 000
2 000
3 000
4 000
5 000



INSET A



INSET B



N

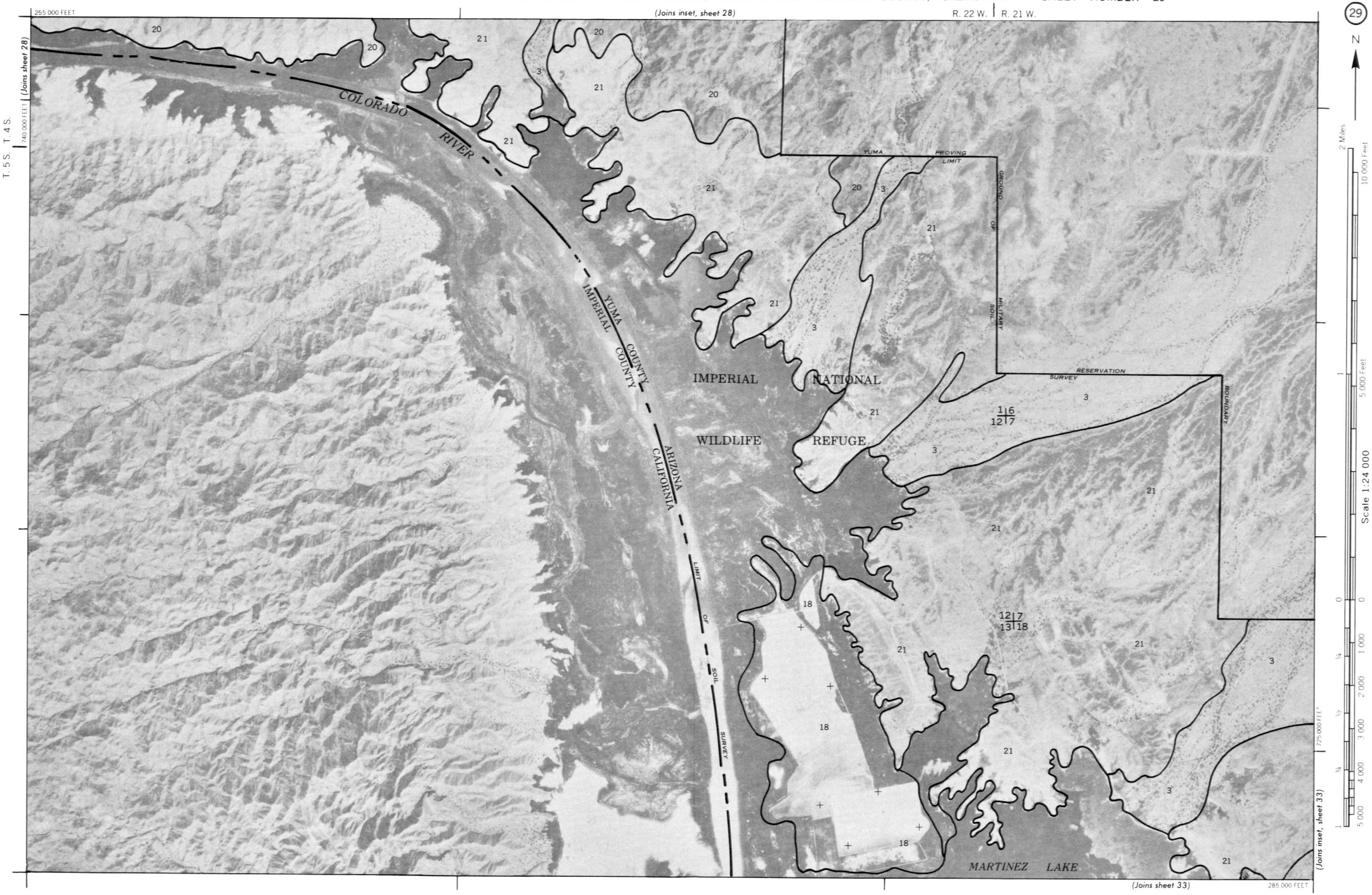
Scale 1:24 000

2 Miles · 1 · ¾ · ½ · ¼ · 0 · 1

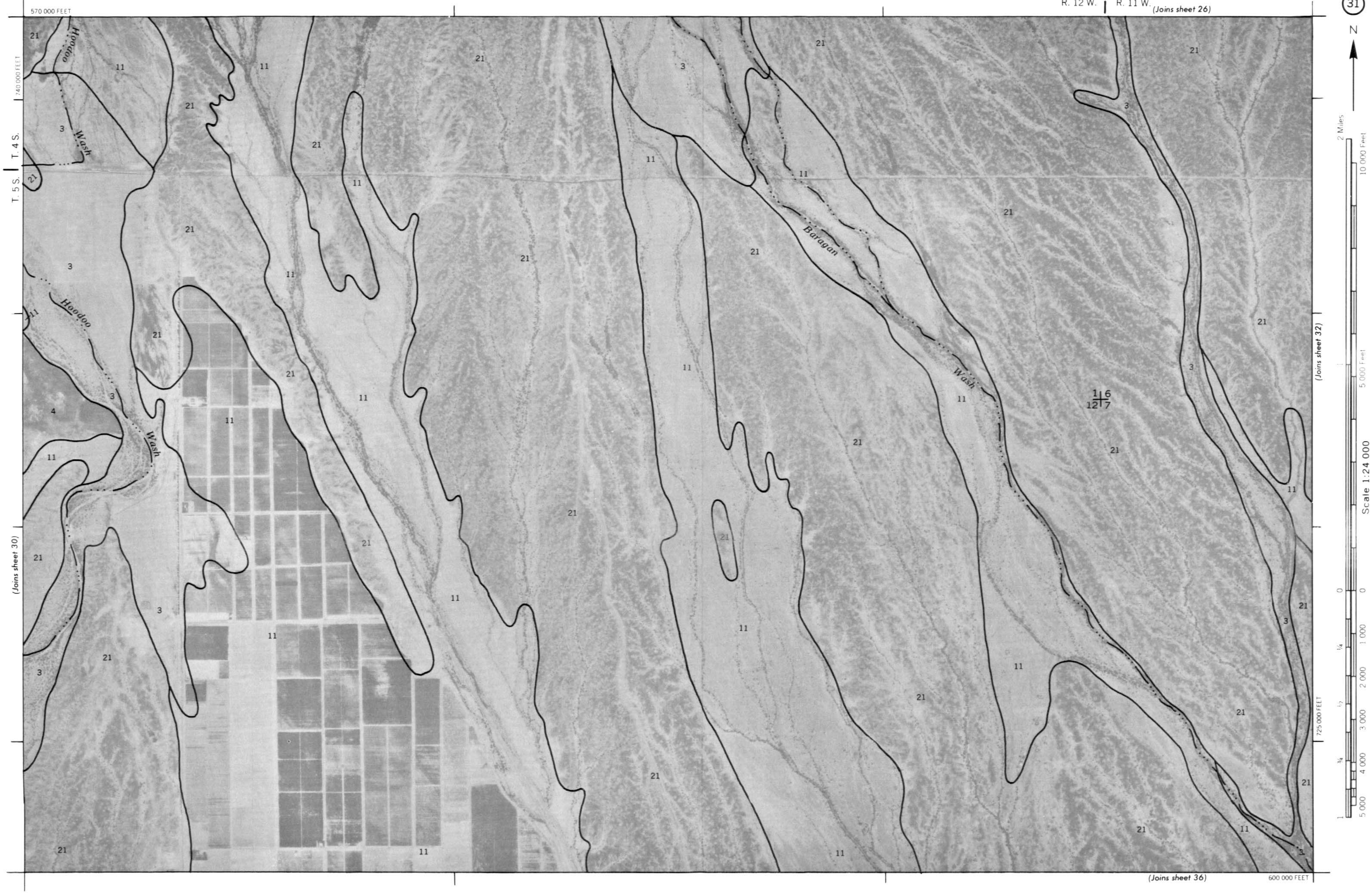
10 000 Feet · 5 000 Feet · 0 · 1 000 · 2 000 · 3 000 · 4 000 · 5 000

725 000 FEET

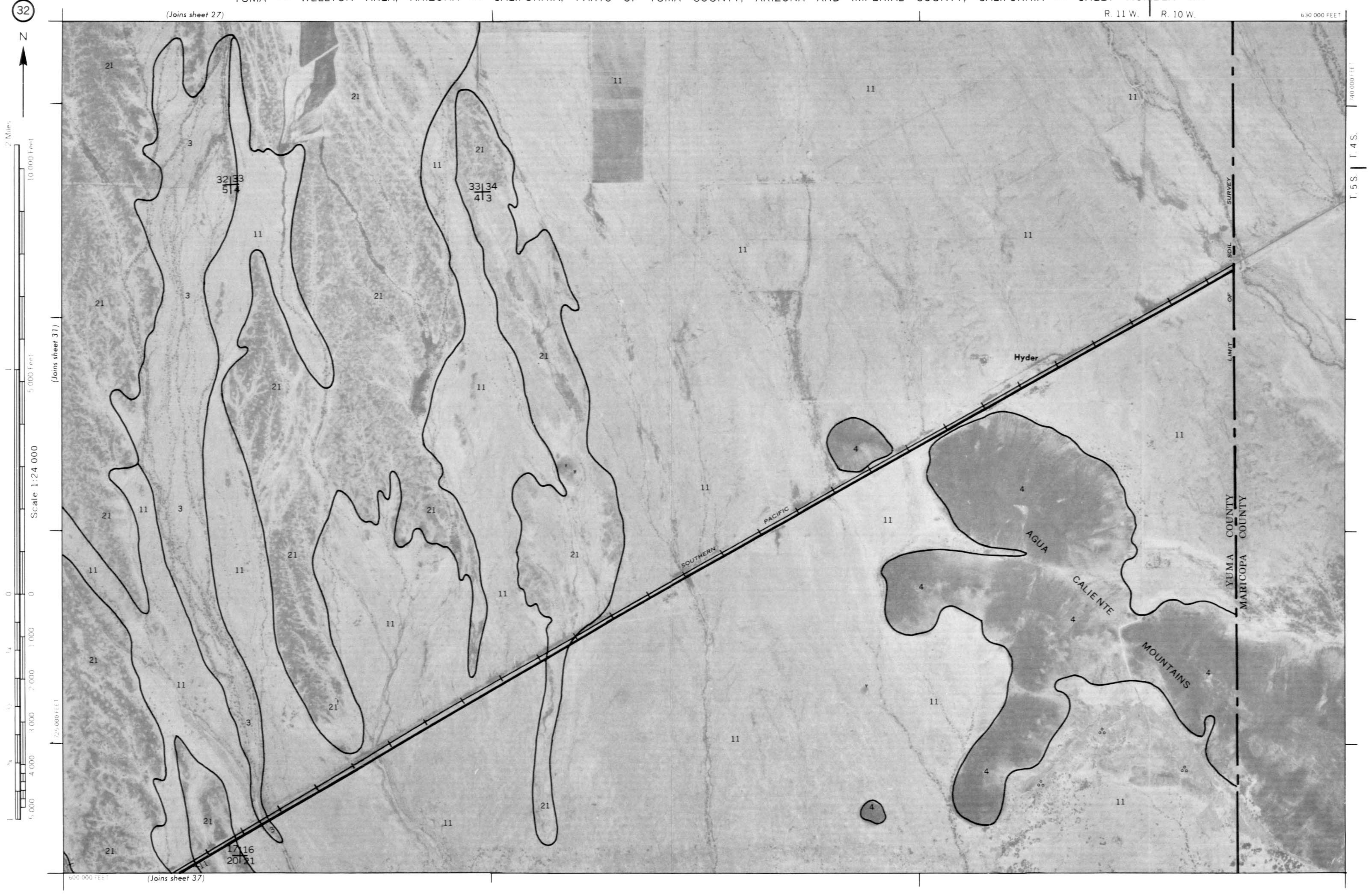
225 000 FEET

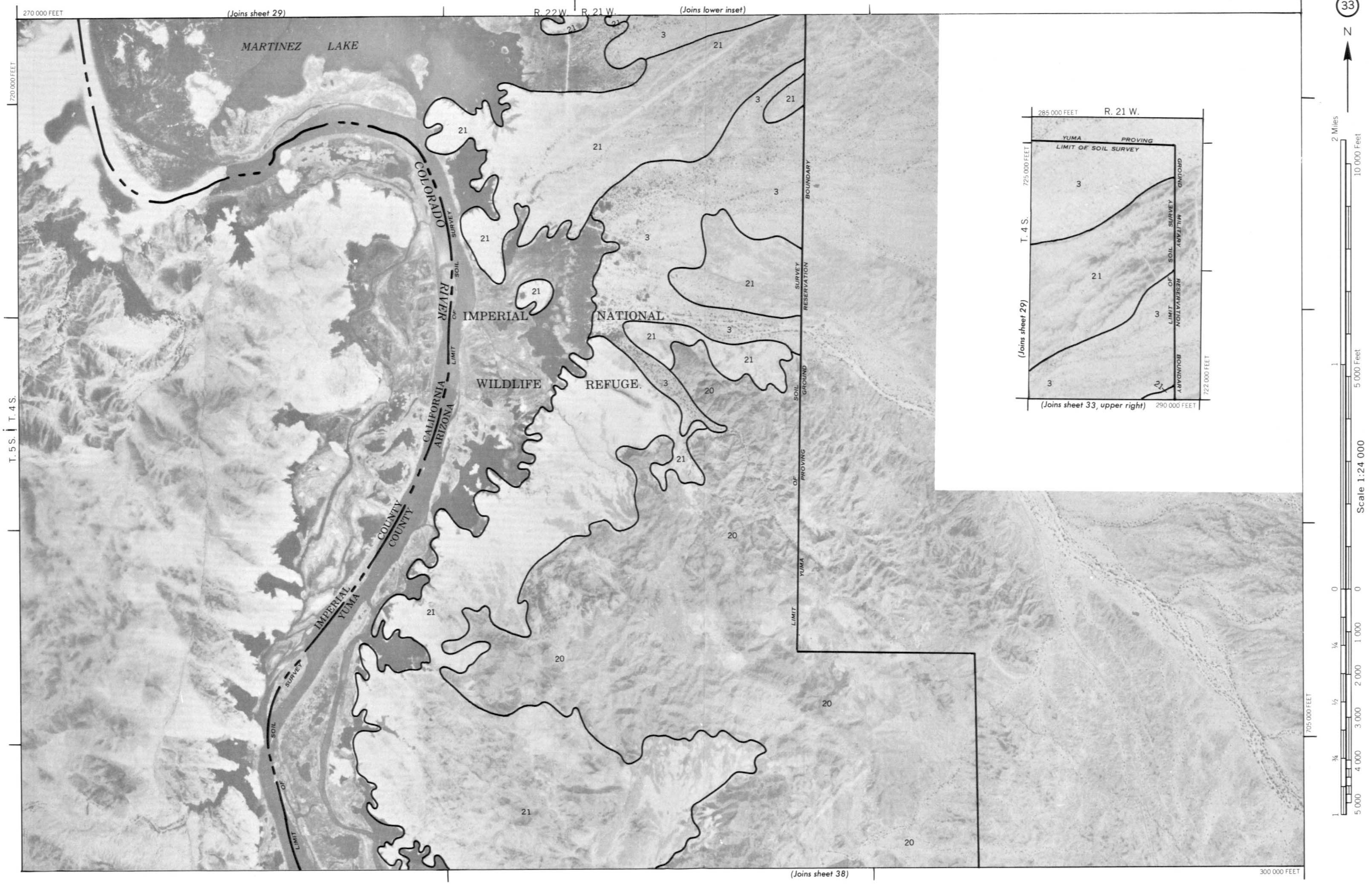

255 000 FEET
(Joins inset, sheet 28)
R. 22 W.
R. 21 W.
29
N
(Joins sheet 28)
740 000 FEET
T. 4 S.
T. 5 S.
COLORADO
RIVER
YUMA
IMPERIAL
COUNTY
COUNTY
ARIZONA
CALIFORNIA
LIMIT
OF
SOIL
SURVEY
IMPERIAL
NATIONAL
WILDLIFE
REFUGE
YUMA
PROVING
LIMIT
GROUND
OF
MILITARY
SOIL
SURVEY
RESERVATION
BOUNDARY
MARTINEZ
LAKE
20
21
3
18
1
6
12
7
12
7
13
18
2 Miles
10 000 Feet
5 000 Feet
Scale 1:24 000
725 000 FEET
(Joins inset, sheet 33)
(Joins sheet 33)
285 000 FEET

YUMA — WELLTON AREA, ARIZONA — CALIFORNIA, PARTS OF YUMA COUNTY, ARIZONA AND IMPERIAL COUNTY, CALIFORNIA — SHEET NUMBER 30



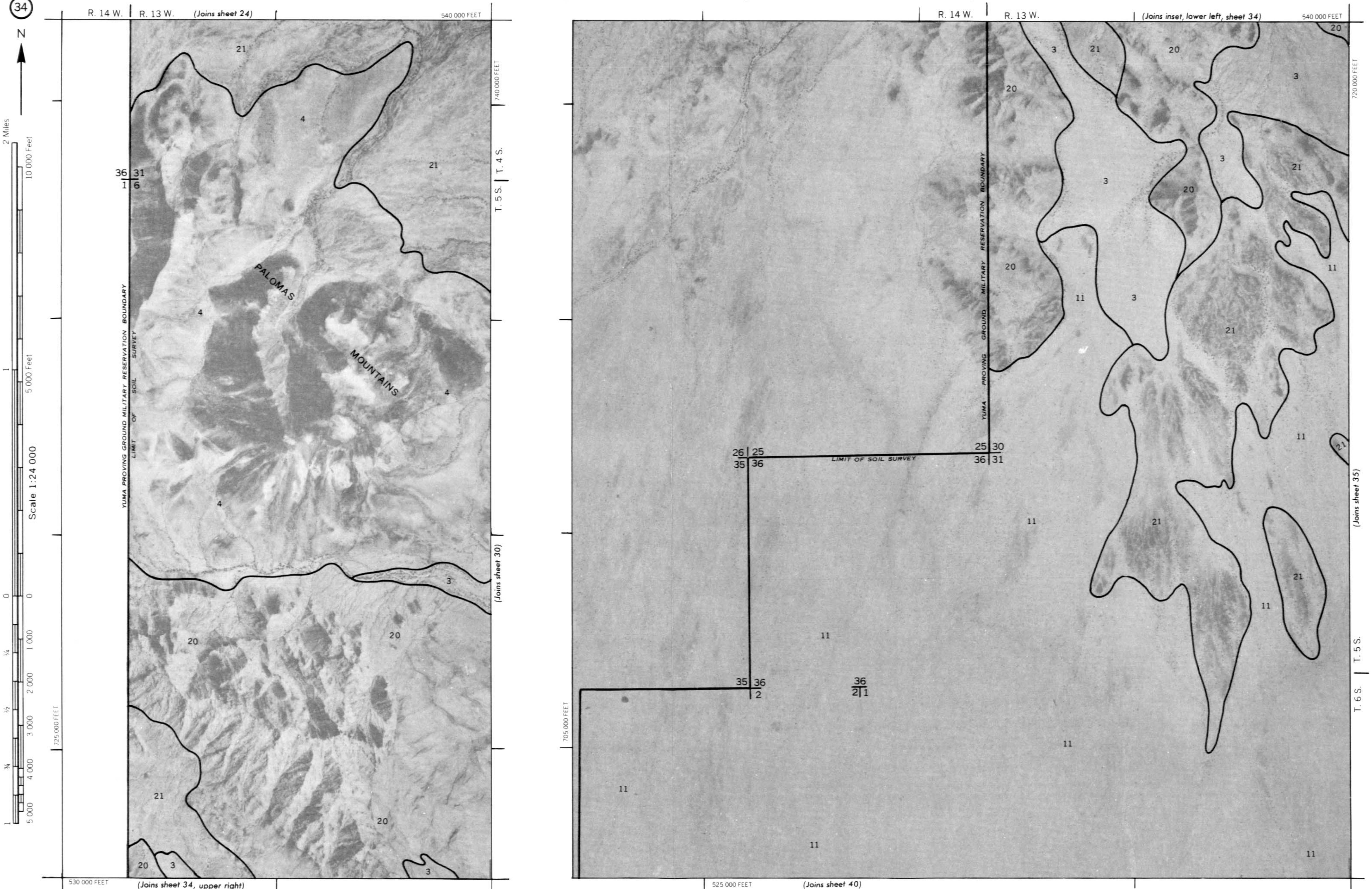
(31)
R. 12 W.
R. 11 W.
(Joins sheet 26)
570 000 FEET
740 000 FEET
T. 4 S.
T. 5 S.
(Joins sheet 30)
(Joins sheet 32)
(Joins sheet 36)
600 000 FEET
725 000 FEET
Hoodoo
Wash
Baragan
Wash
N
2 Miles
10 000 Feet
5 000 Feet
Scale 1:24 000
0
1/4
1/2
3/4
1
1 000
2 000
3 000
4 000
5 000
21
11
3
4

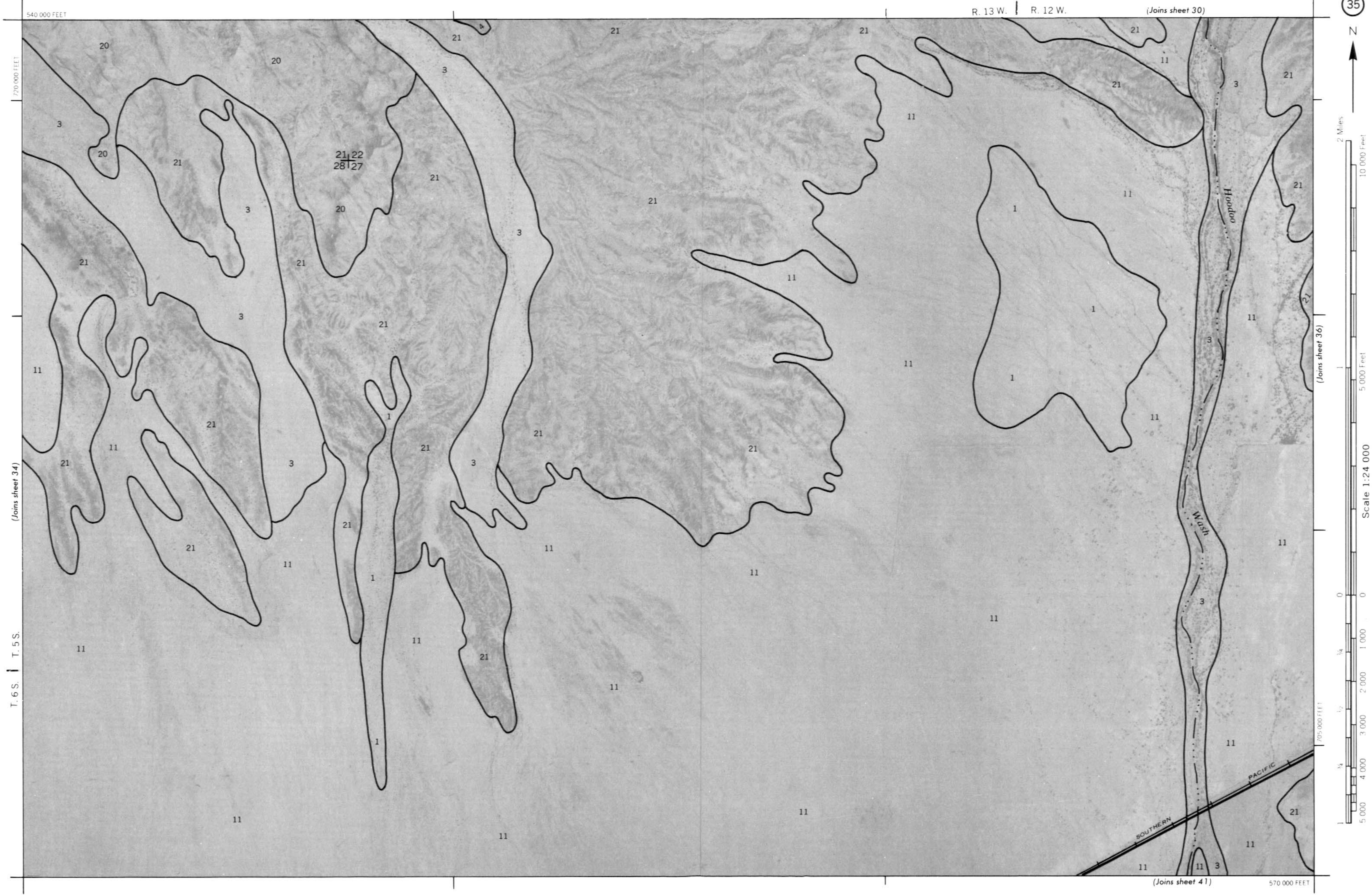

32
N
(Joins sheet 27)
(Joins sheet 31)
(Joins sheet 37)
R. 11 W.
R. 10 W.
T. 4 S.
T. 5 S.
630 000 FEET
600 000 FEET
Scale 1:24 000
2 Miles
10 000 Feet
5 000 Feet
Hyder
SOUTHERN PACIFIC
AGUA CALIENTE MOUNTAINS
YUMA COUNTY
MARICOPA COUNTY
LIMIT OF SOIL SURVEY
21
3
11
4
32 33
5 4
33 34
4 3
17 16
20 21



(Joins sheet 29)
R. 22 W.
R. 21 W.
(Joins lower inset)
270 000 FEET
720 000 FEET
MARTINEZ LAKE
COLORADO RIVER
LIMIT OF SOIL SURVEY
IMPERIAL NATIONAL WILDLIFE REFUGE
CALIFORNIA
ARIZONA
IMPERIAL COUNTY
YUMA COUNTY
LIMIT OF SOIL SURVEY
YUMA PROVING GROUND RESERVATION BOUNDARY
T. 5 S.
T. 4 S.
3
21
20
705 000 FEET
300 000 FEET
(Joins sheet 38)
285 000 FEET
R. 21 W.
YUMA PROVING
LIMIT OF SOIL SURVEY
725 000 FEET
T. 4 S.
(Joins sheet 29)
MILITARY RESERVATION BOUNDARY
GROUND
722 000 FEET
(Joins sheet 33, upper right)
290 000 FEET
33
N
2 Miles
10 000 Feet
1
5 000 Feet
Scale 1:24 000
0
1 000
¼
2 000
½
3 000
¾
4 000
1
5 000

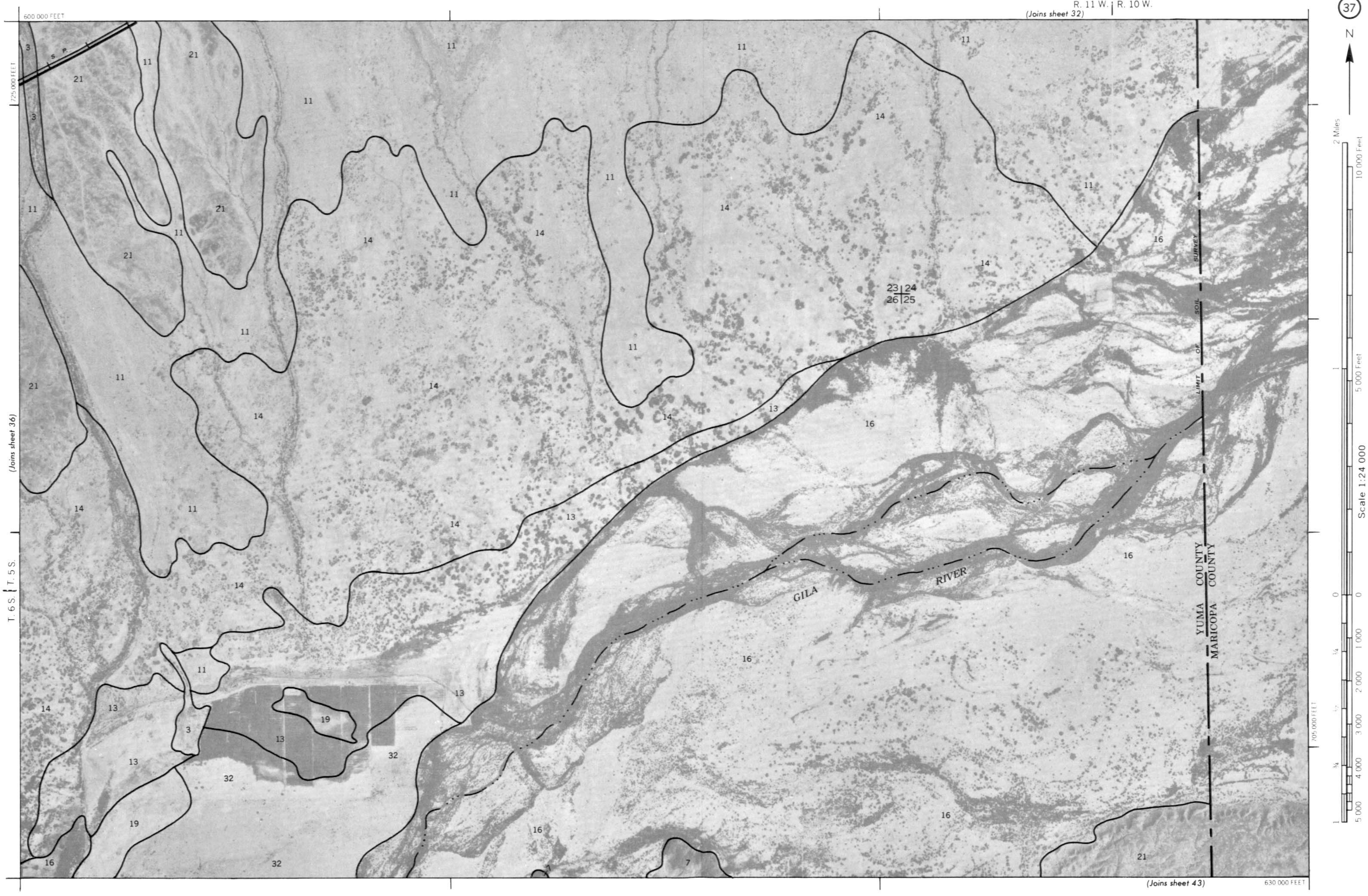
YUMA – WELLTON AREA, ARIZONA – CALIFORNIA, PARTS OF YUMA COUNTY, ARIZONA AND IMPERIAL COUNTY, CALIFORNIA – SHEET NUMBER 34

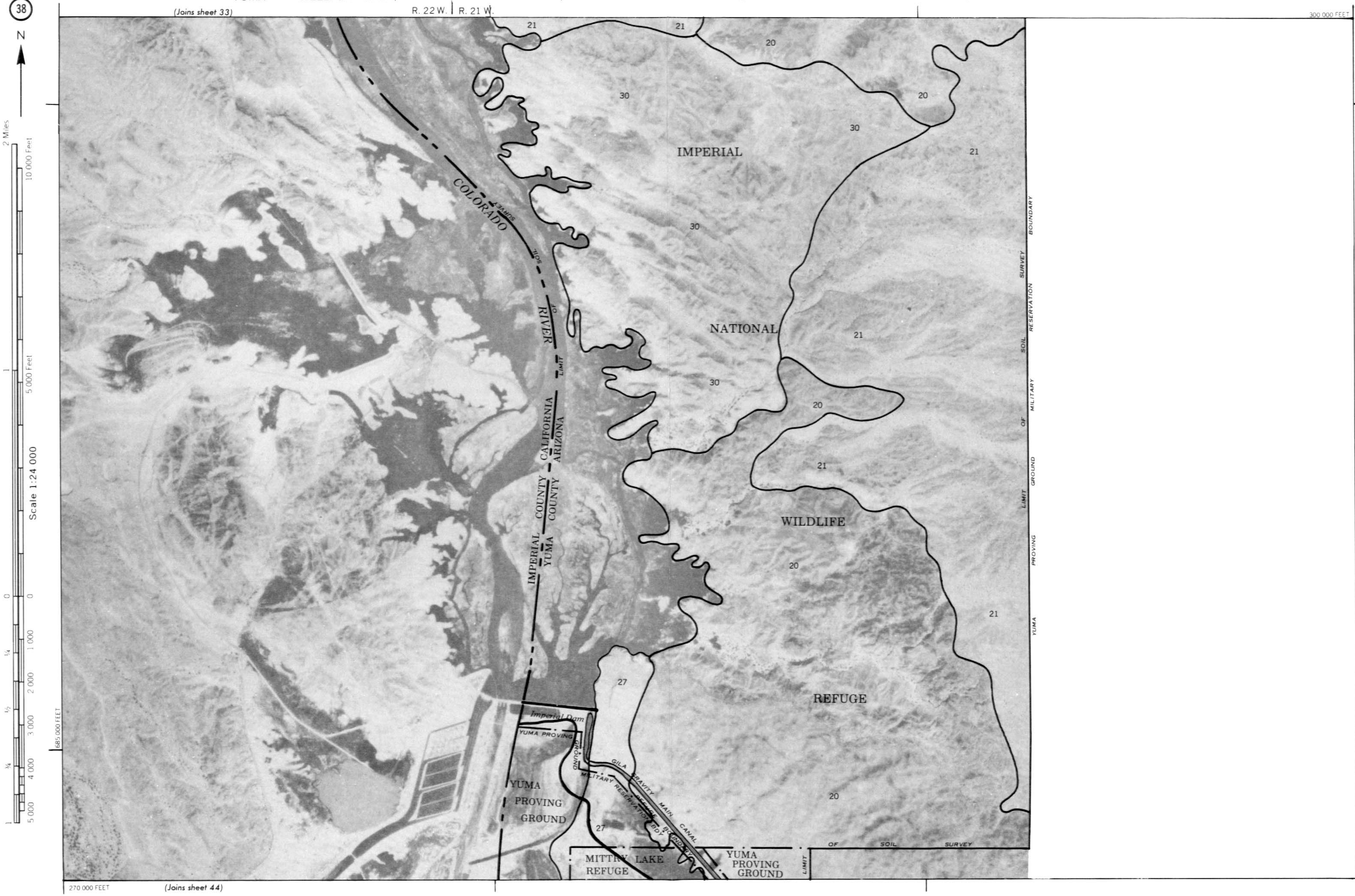


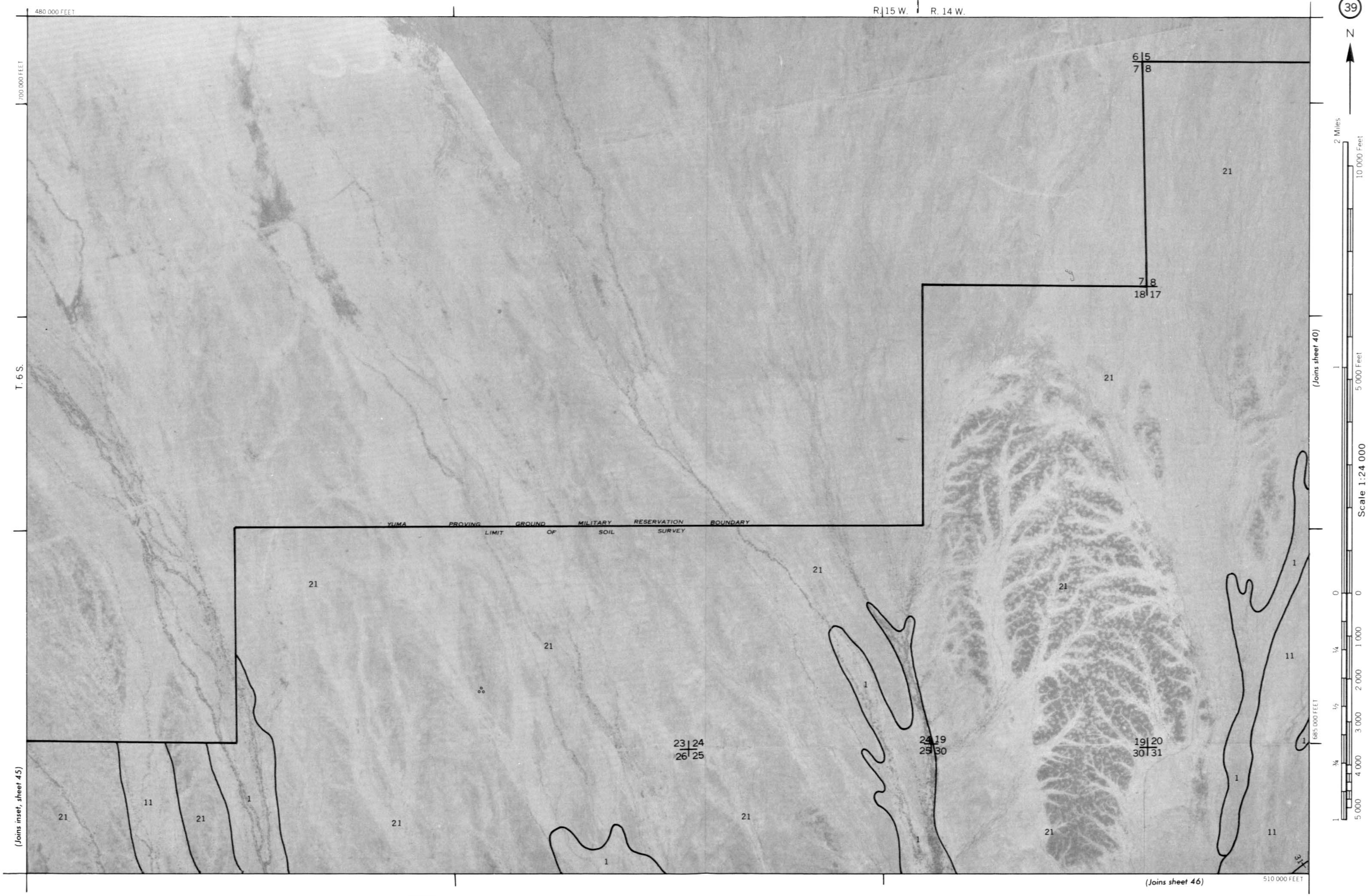

35
R. 13 W.
R. 12 W.
(Joins sheet 30)
(Joins sheet 34)
(Joins sheet 36)
(Joins sheet 41)
540 000 FEET
720 000 FEET
705 000 FEET
570 000 FEET
T. 5 S.
T. 6 S.
Hoodoo
Wash
SOUTHERN
PACIFIC
N
Scale 1:24 000
2 Miles
1
0
10 000 Feet
5 000 Feet
0
1 000
2 000
3 000
4 000
5 000
21 22
28 27
1
3
4
11
20
21

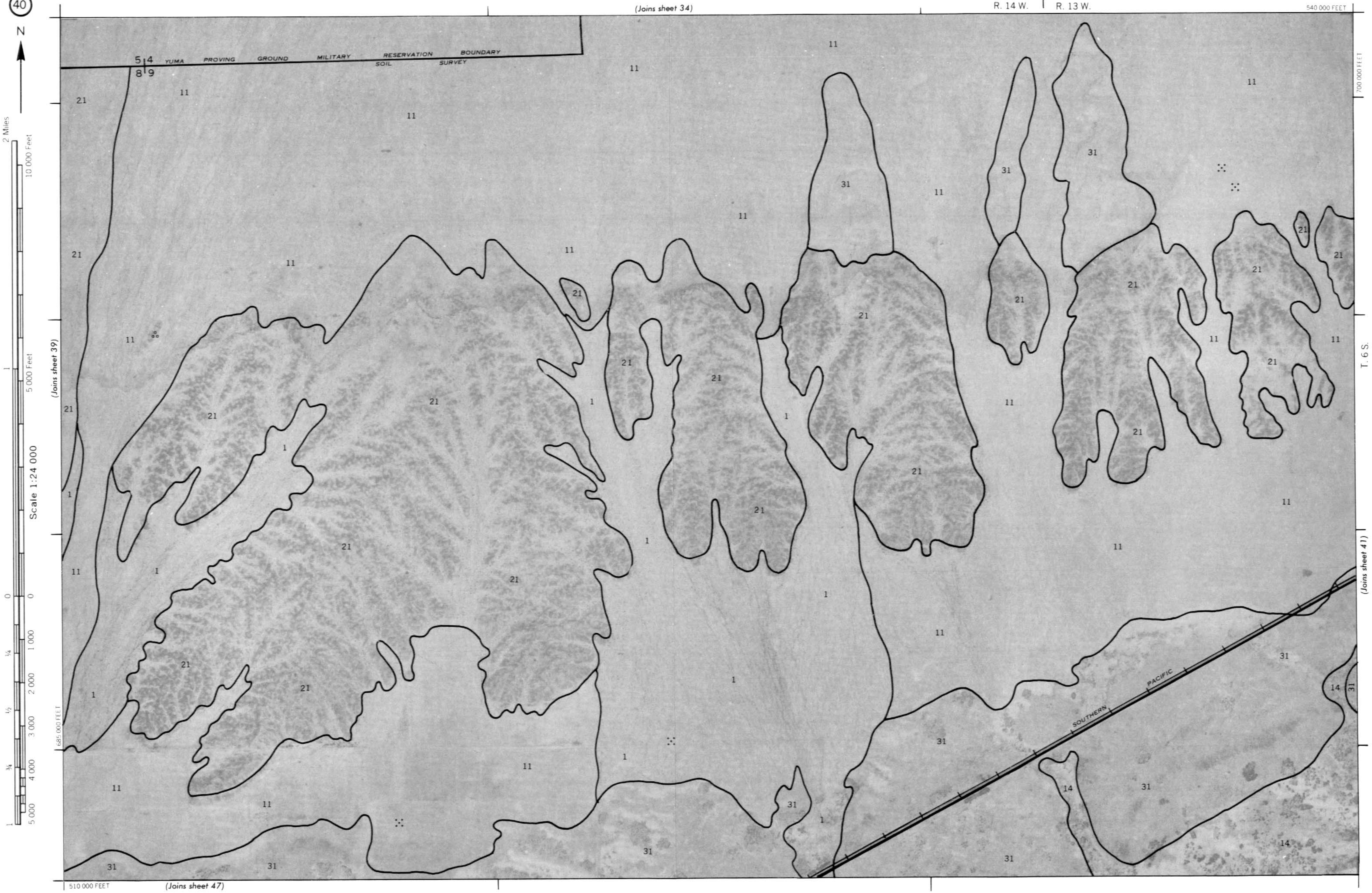

36
N
(Joins sheet 31)
R. 12 W.
R. 11 W.
600 000 FEET
720 000 FEET
(Joins sheet 35)
(Joins sheet 37)
(Joins sheet 42)
570 000 FEET
705 000 FEET
SOUTHERN PACIFIC
27 26
34 35
T. 6 S. | T. 5 S.
Scale 1:24 000
2 Miles
1
½
¼
¾
0
10 000 Feet
5 000 Feet
0
1 000
2 000
3 000
4 000
5 000
3
11
14
16
21

YUMA — WELLTON AREA, ARIZONA — CALIFORNIA, PARTS OF YUMA COUNTY, ARIZONA AND IMPERIAL COUNTY, CALIFORNIA — SHEET NUMBER 37

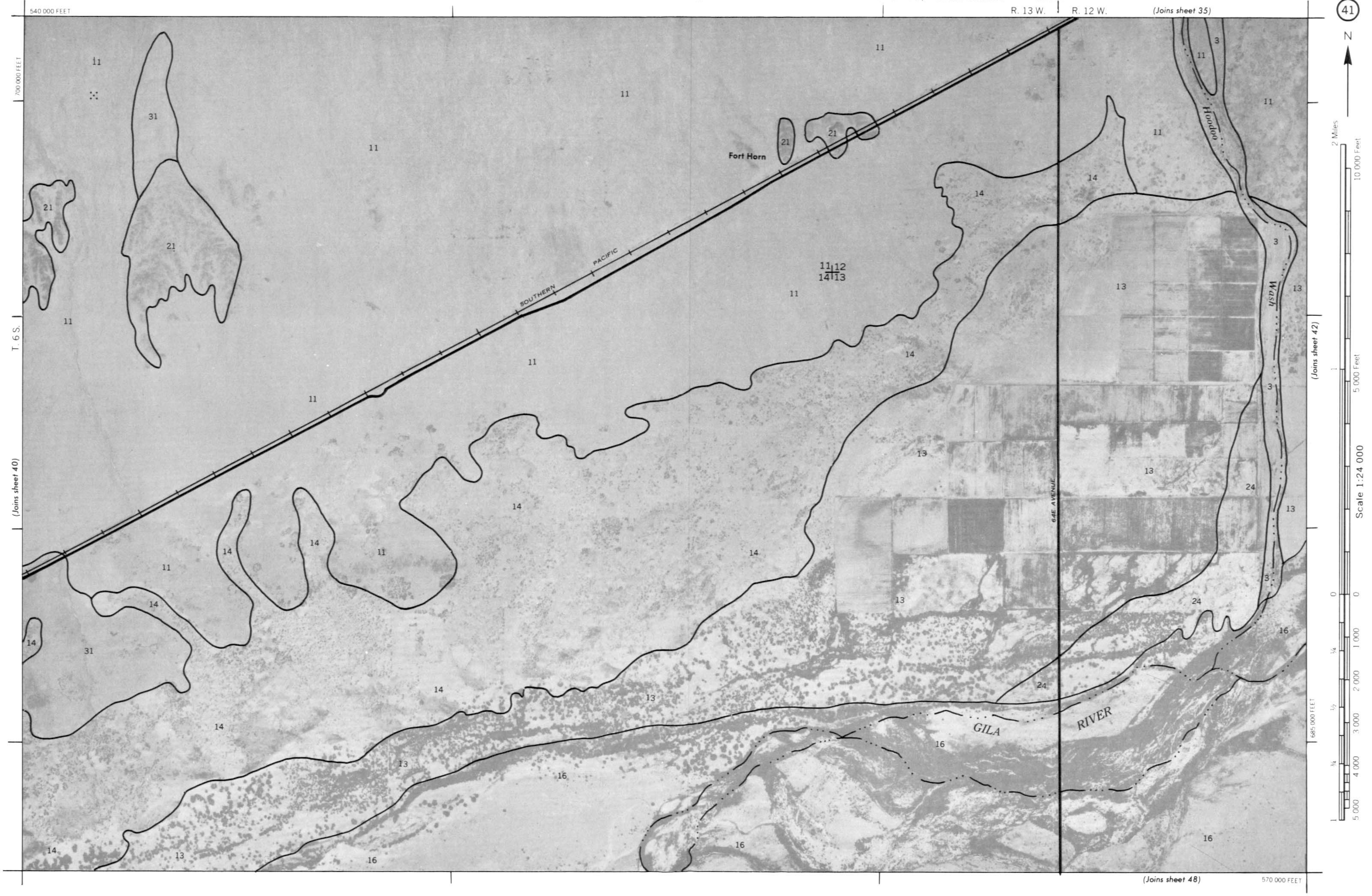



38
N
(Joins sheet 33)
R. 22 W.
R. 21 W.
300 000 FEET
700 000 FEET
685 000 FEET
270 000 FEET
(Joins sheet 44)
T. 6 S.
T. 5 S.
Scale 1:24 000
2 Miles
10 000 Feet
5 000 Feet
IMPERIAL
NATIONAL
WILDLIFE
REFUGE
COLORADO
RIVER
IMPERIAL COUNTY
YUMA COUNTY
CALIFORNIA
ARIZONA
SOIL SURVEY LIMIT
Imperial Dam
YUMA PROVING GROUND
GILA GRAVITY MAIN CANAL
MILITARY RESERVATION BOUNDARY
MITTRY LAKE
REFUGE
YUMA
PROVING
GROUND
YUMA PROVING GROUND MILITARY RESERVATION SOIL SURVEY BOUNDARY
LIMIT OF SOIL SURVEY
21
20
30
27

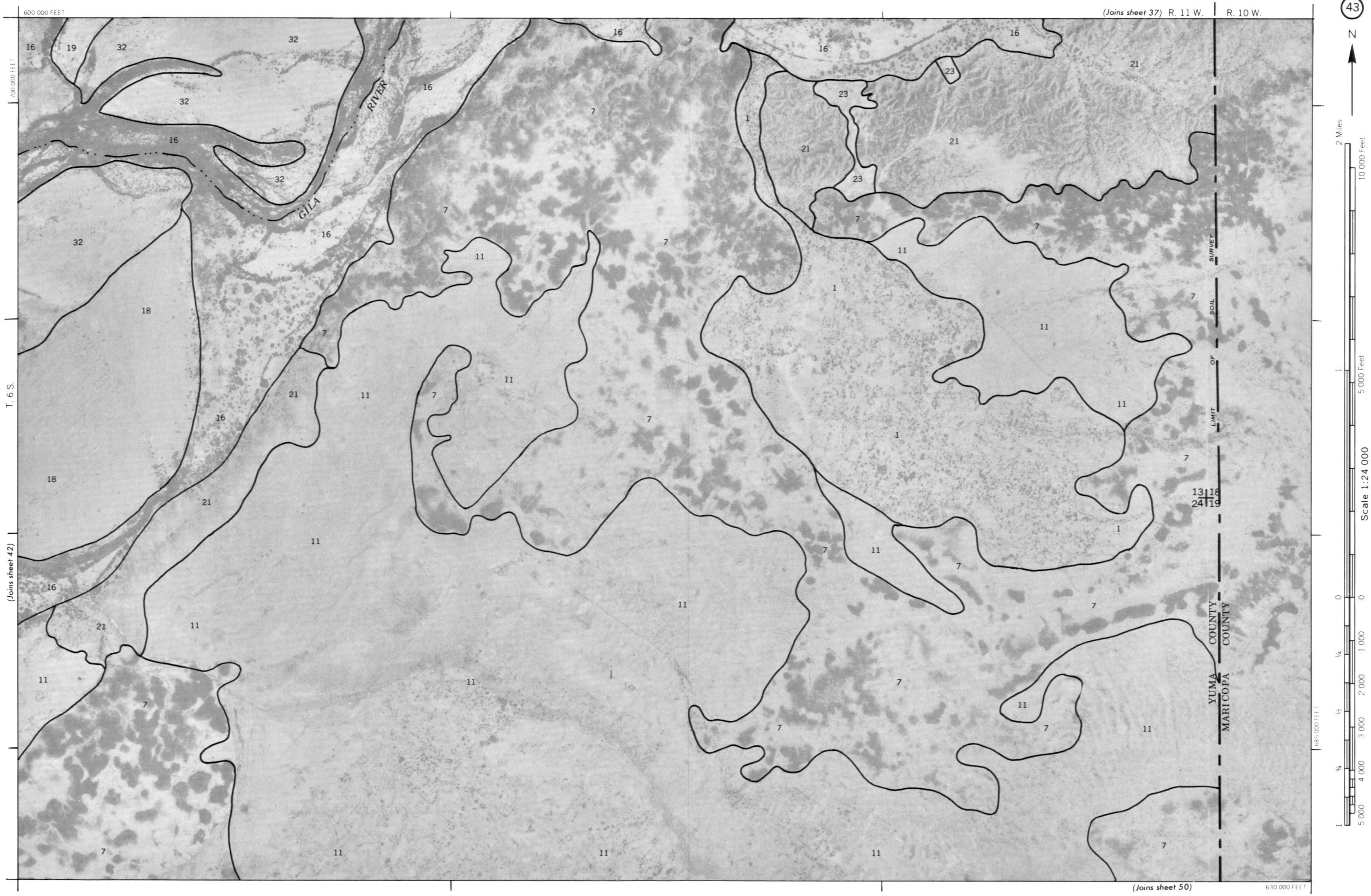

39
N
480 000 FEET
700 000 FEET
685 000 FEET
510 000 FEET
R. 15 W.
R. 14 W.
T. 6 S.
YUMA PROVING GROUND MILITARY RESERVATION BOUNDARY
LIMIT OF SOIL SURVEY
(Joins sheet 40)
(Joins sheet 46)
(Joins inset, sheet 45)
21
1
11
Scale 1:24 000
2 Miles
1
0
10 000 Feet
5 000 Feet
1 000
2 000
3 000
4 000
5 000

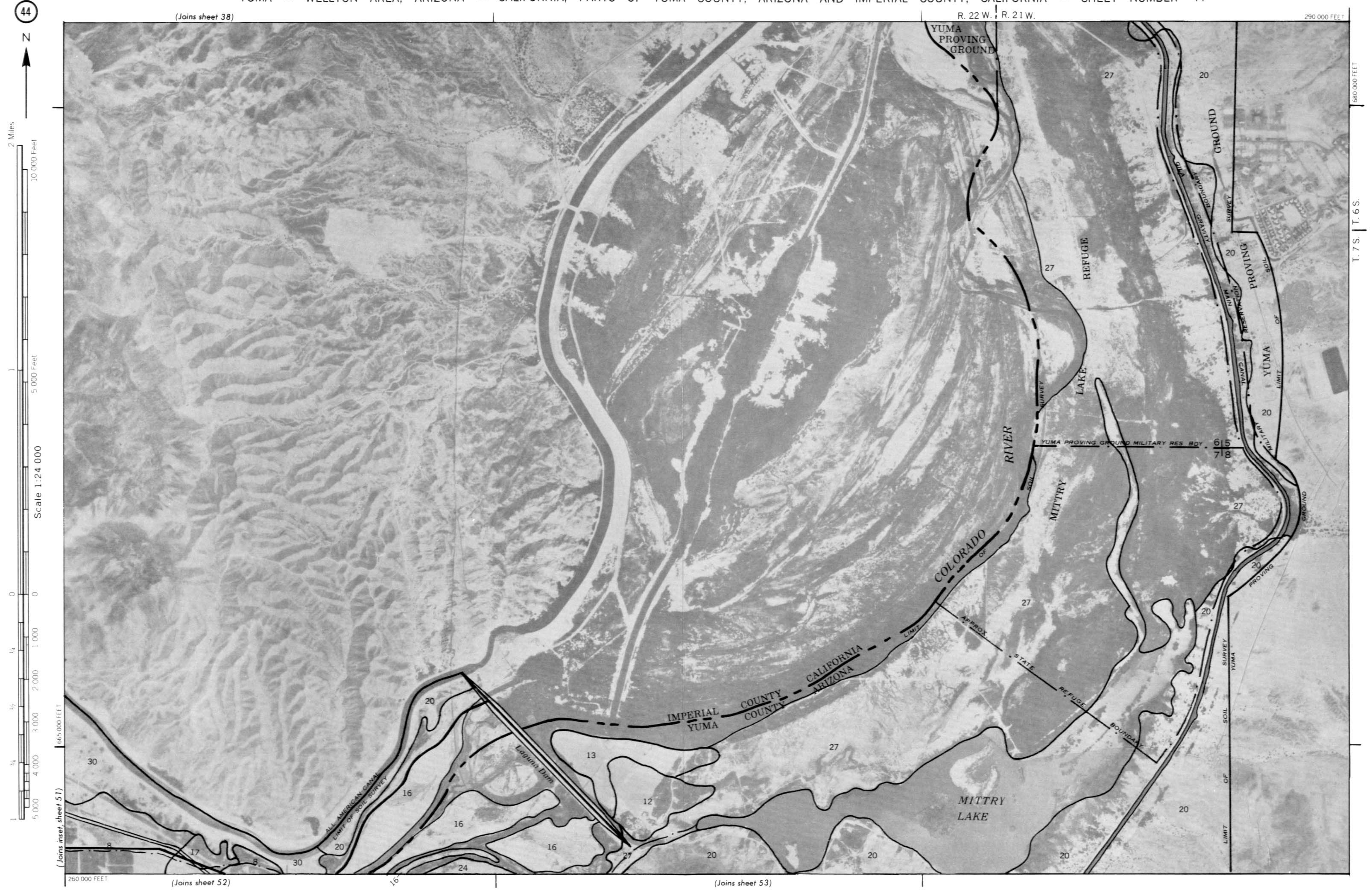

40
N
(Joins sheet 34)
R. 14 W.
R. 13 W.
540 000 FEET
700 000 FEET
YUMA PROVING GROUND MILITARY RESERVATION BOUNDARY
SOIL SURVEY
5 4
8 9
(Joins sheet 39)
(Joins sheet 41)
T. 6 S.
685 000 FEET
510 000 FEET
(Joins sheet 47)
SOUTHERN PACIFIC
Scale 1:24 000
2 Miles
10 000 Feet
5 000 Feet
1
0
¼
½
¾
1 000
2 000
3 000
4 000
5 000
1
11
21
31
14

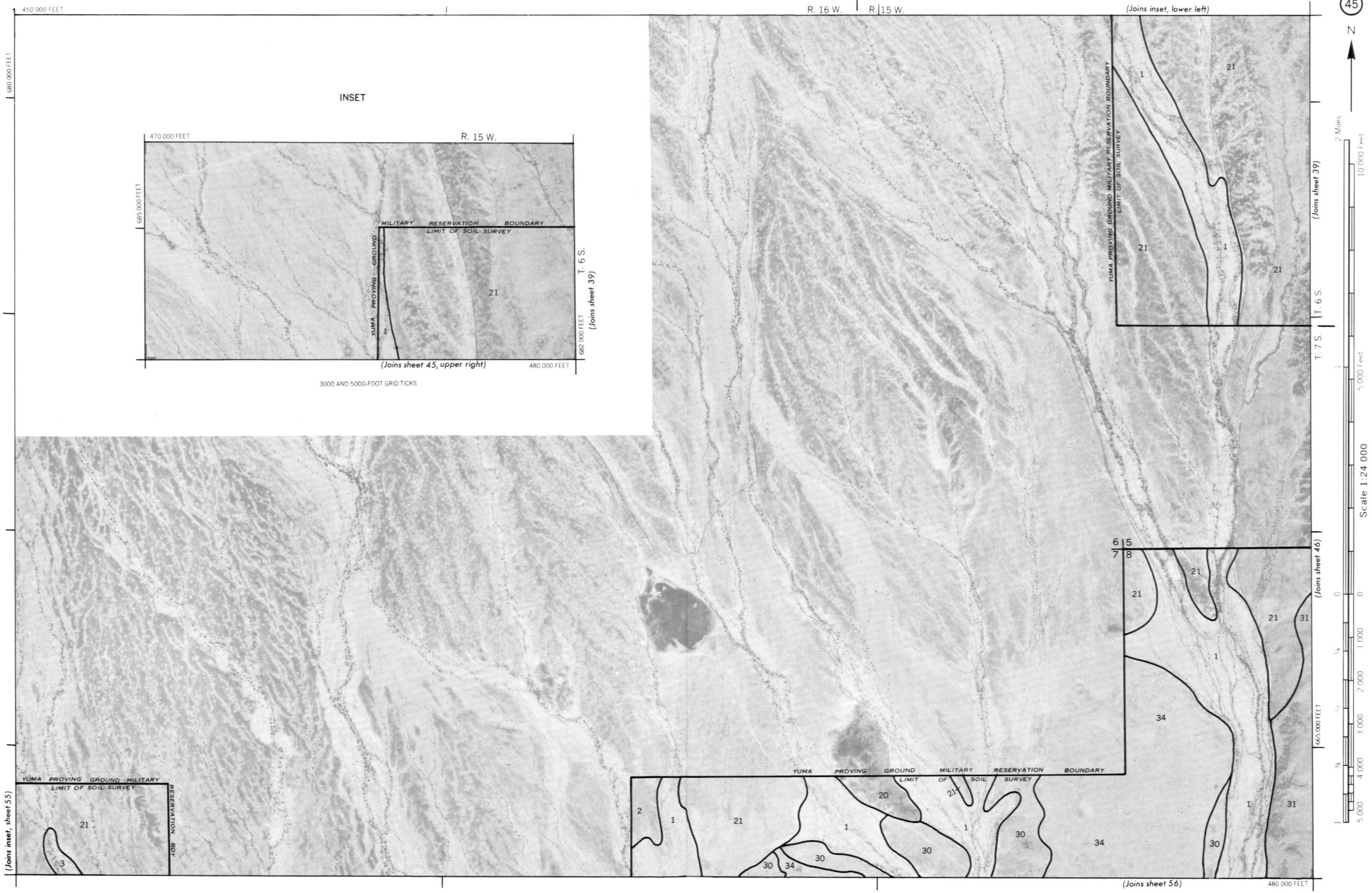
YUMA — WELLTON AREA, ARIZONA — CALIFORNIA, PARTS OF YUMA COUNTY, ARIZONA AND IMPERIAL COUNTY, CALIFORNIA — SHEET NUMBER 41

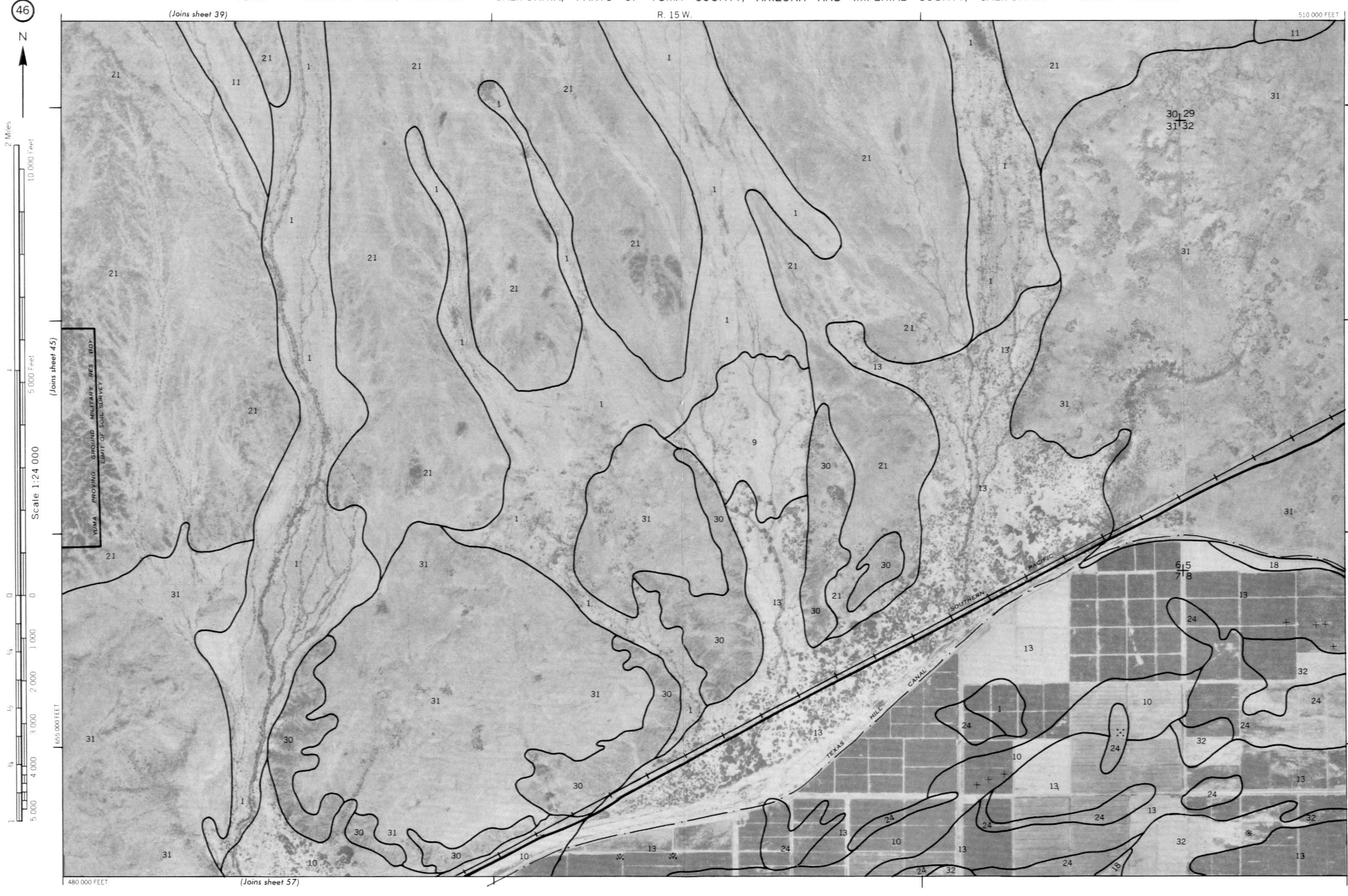



42
N
(Joins sheet 36)
R. 12 W.
R. 11 W.
600 000 FEET
700 000 FEET
(Joins sheet 41)
(Joins sheet 43)
(Joins sheet 49)
570 000 FEET
685 000 FEET
T. 6 S.
GILA
RIVER
Ten mile Wash
15 14
22 23
2 Miles
10 000 Feet
5 000 Feet
Scale 1:24 000
11
13
14
16
18
21
23
32
7

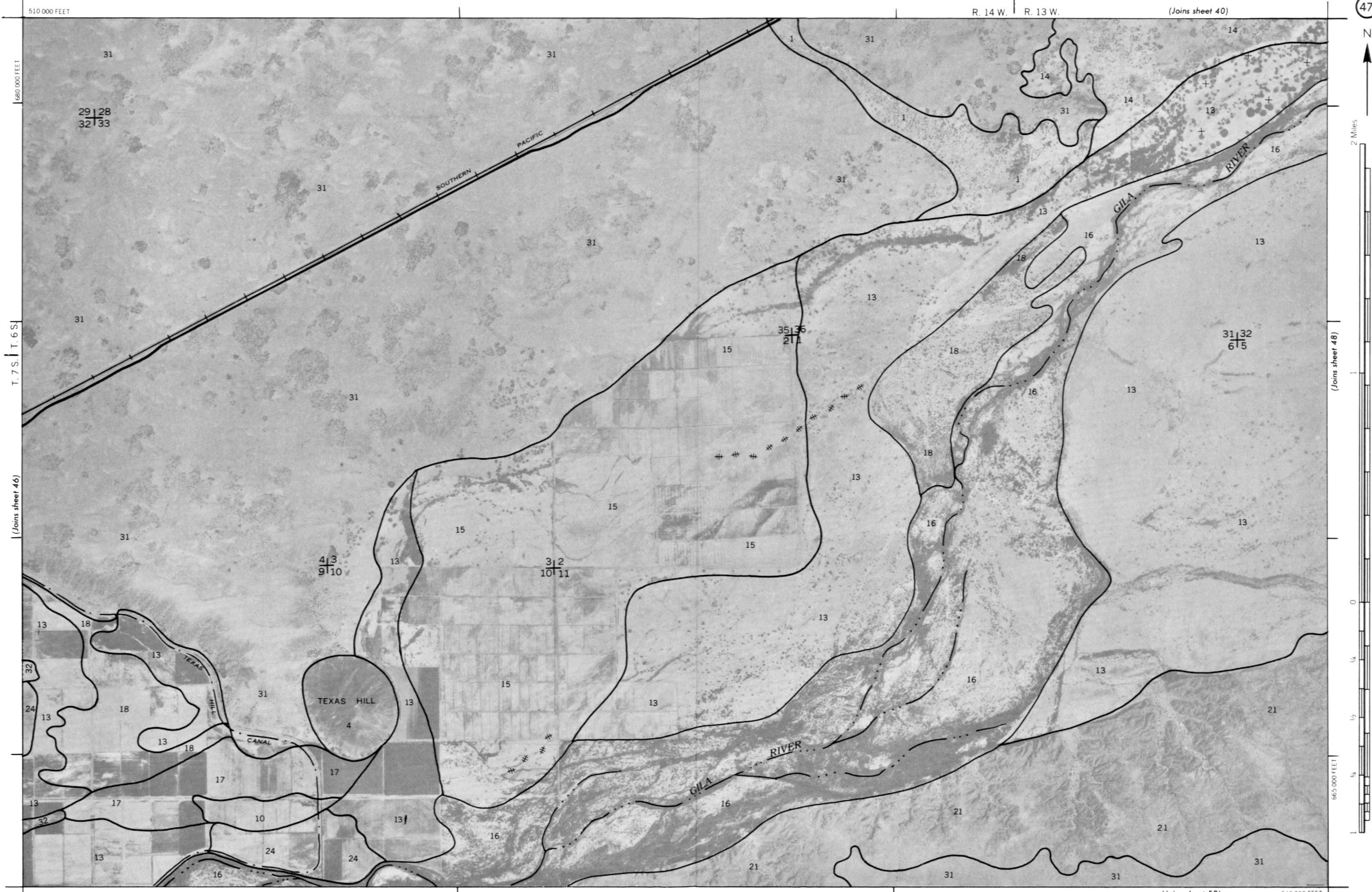

43
N
(Joins sheet 37)
R. 11 W.
R. 10 W.
600 000 FEET
700 000 FEET
685 000 FEET
630 000 FEET
T. 6 S.
(Joins sheet 42)
(Joins sheet 50)
GILA
RIVER
SURVEY
OF
SOIL
LIMIT
YUMA
COUNTY
MARICOPA
COUNTY
13
18
24
19
Scale 1:24 000
2 Miles
10 000 Feet
5 000 Feet
1
0
1/4
1/2
3/4
1 000
2 000
3 000
4 000
5 000

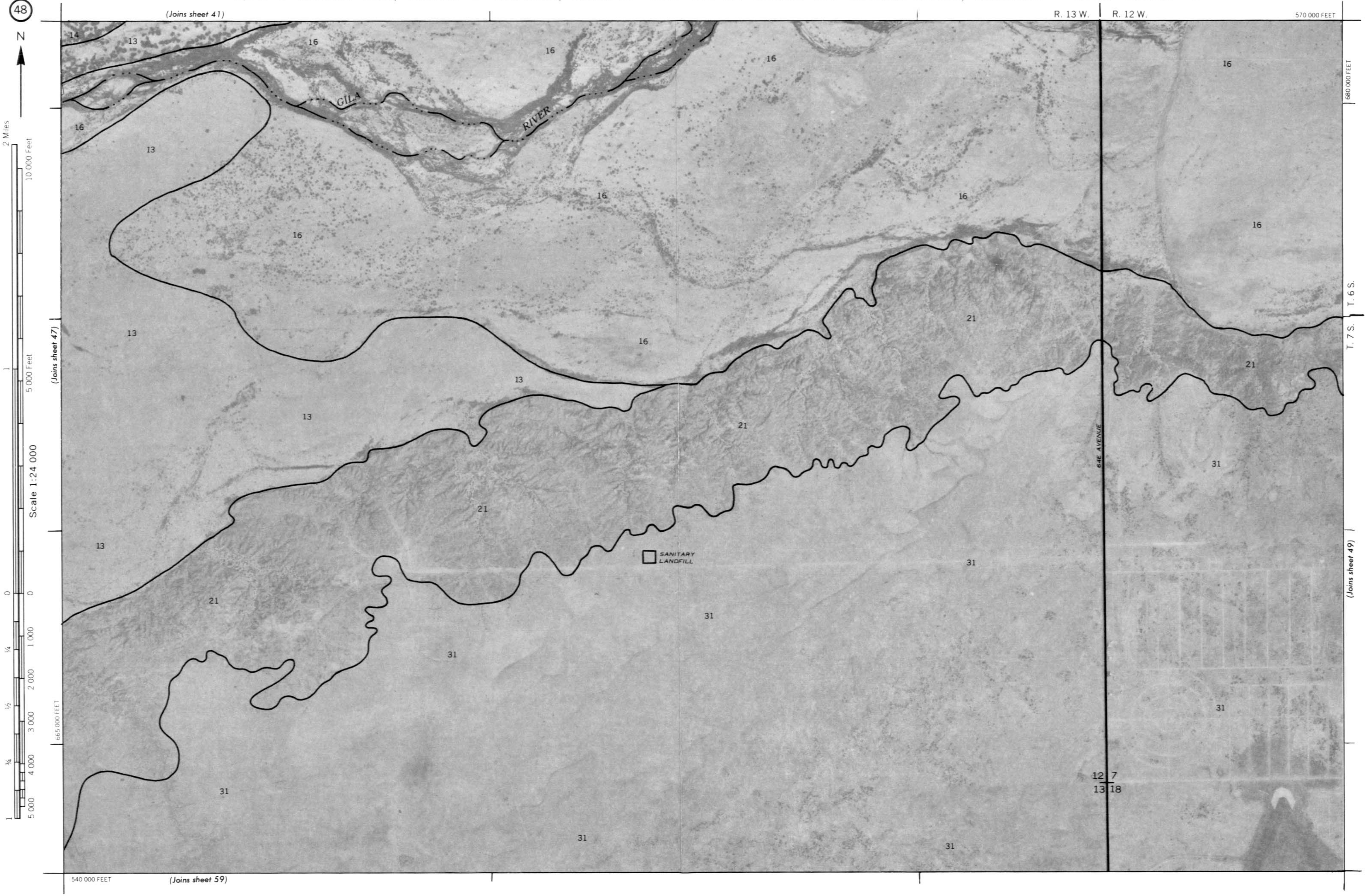

44
N
2 Miles
10 000 Feet
1
5 000 Feet
Scale 1:24 000
0
0
1 000
2 000
3 000
4 000
5 000
(Joins sheet 38)
R. 22 W. R. 21 W.
290 000 FEET
680 000 FEET
T. 6 S.
T. 7 S.
665 000 FEET
260 000 FEET
(Joins sheet 52)
(Joins sheet 53)
(Joins inset, sheet 51)
YUMA PROVING GROUND
GILA GRAVITY CANAL
YUMA PROVING GROUND
SOIL SURVEY LIMIT
MILITARY RESERVATION BOUNDARY
YUMA PROVING GROUND MILITARY RES BDY
REFUGE
LAKE
MITTRY
SOIL SURVEY LIMIT
COLORADO RIVER
CALIFORNIA
ARIZONA
IMPERIAL COUNTY
YUMA COUNTY
APPROX STATE REFUGE BOUNDARY
LIMIT OF SOIL SURVEY
ALL AMERICAN CANAL
Laguna Dam
MITTRY LAKE
LIMIT OF SOIL SURVEY YUMA
6 5
7 8
27
20
13
12
16
30
8
17
24

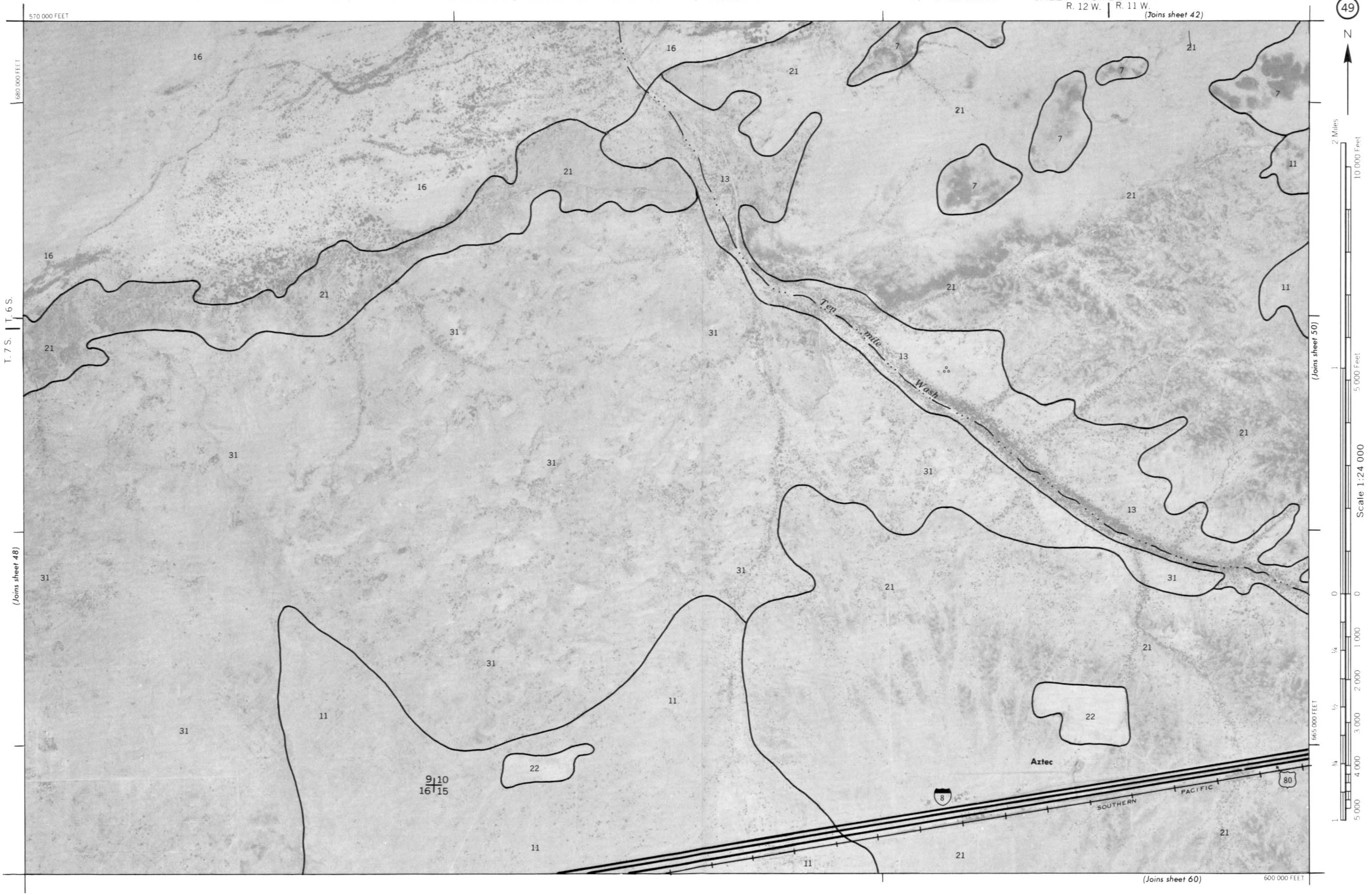

450 000 FEET
R. 16 W.
R. 15 W.
(Joins inset, lower left)
680 000 FEET
INSET
470 000 FEET
R. 15 W.
685 000 FEET
MILITARY RESERVATION BOUNDARY
LIMIT OF SOIL SURVEY
YUMA PROVING GROUND
T. 6 S.
(Joins sheet 39)
21
1
682 000 FEET
(Joins sheet 45, upper right)
480 000 FEET
3000 AND 5000-FOOT GRID TICKS
YUMA PROVING GROUND MILITARY RESERVATION BOUNDARY
LIMIT OF SOIL SURVEY
(Joins sheet 39)
T. 6 S.
T. 7 S.
(Joins sheet 46)
665 000 FEET
YUMA PROVING GROUND MILITARY RESERVATION BOUNDARY
LIMIT OF SOIL SURVEY
YUMA PROVING GROUND MILITARY RESERVATION BDY
(Joins inset, sheet 55)
(Joins sheet 56)
480 000 FEET
N
Scale 1:24 000
2 Miles
1
0
10 000 Feet
5 000
0
1 000
2 000
3 000
4 000
5 000



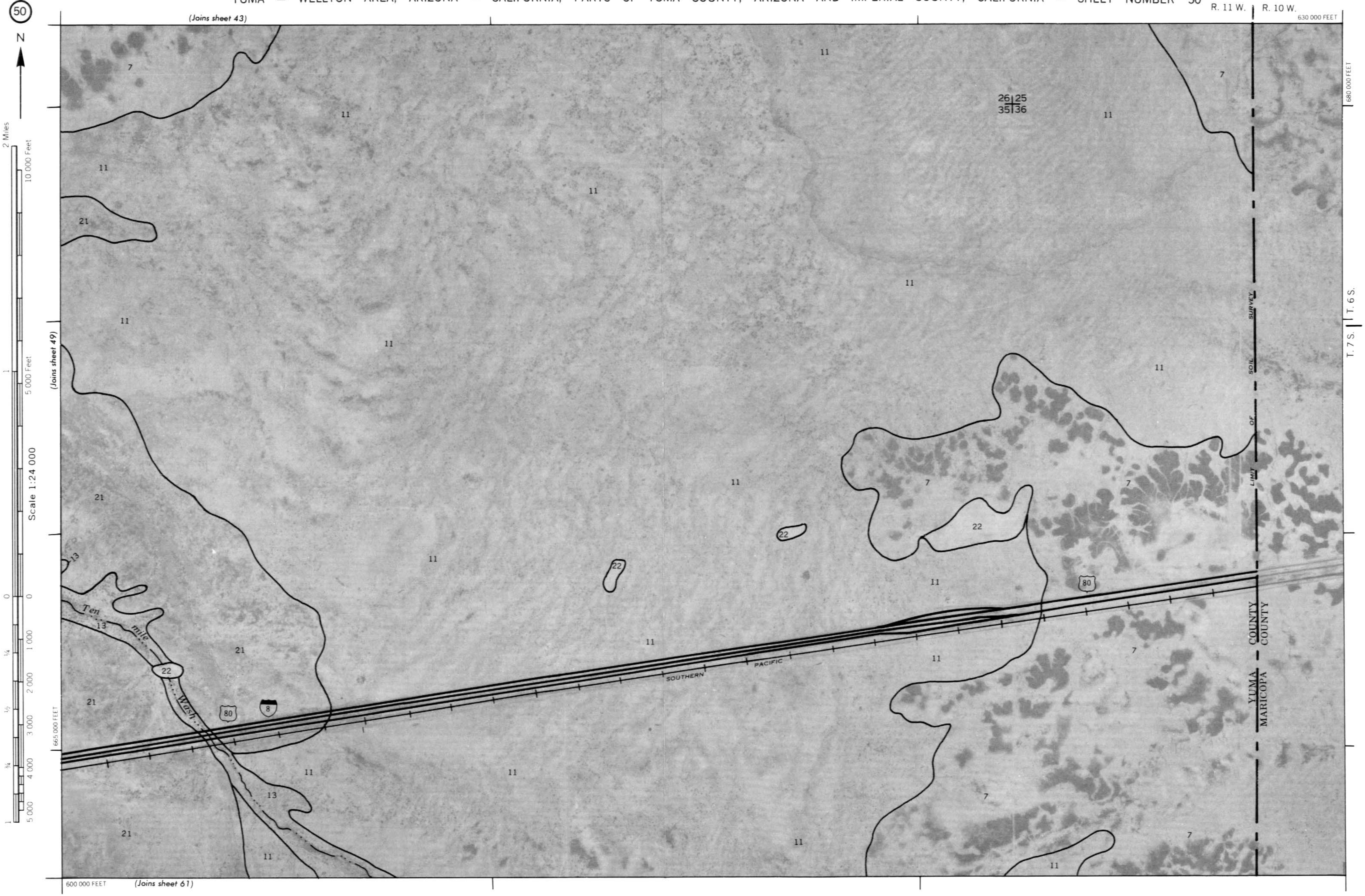
46
N
Scale 1:24 000
2 Miles
10 000 Feet
5 000 Feet
(Joins sheet 39)
(Joins sheet 45)
(Joins sheet 47)
(Joins sheet 57)
R. 15 W.
T. 6 S.
T. 7 S.
510 000 FEET
680 000 FEET
655 000 FEET
480 000 FEET
YUMA PROVING GROUND MILITARY RES. BDY.
LIMIT OF SOIL SURVEY
SOUTHERN PACIFIC
TEXAS HILL CANAL
30 29
31 32
6 5
7 8


47
N
510 000 FEET
680 000 FEET
R. 14 W.
R. 13 W.
(Joins sheet 40)
(Joins sheet 46)
(Joins sheet 48)
(Joins sheet 58)
T. 7 S.
T. 6 S.
SOUTHERN PACIFIC
GILA RIVER
TEXAS HILL
TEXAS HILL CANAL
665 000 FEET
540 000 FEET
Scale 1:24 000
2 Miles
10 000 Feet
5 000 Feet


48
N
(Joins sheet 41)
(Joins sheet 47)
(Joins sheet 49)
(Joins sheet 59)
R. 13 W.
R. 12 W.
T. 6 S.
T. 7 S.
570 000 FEET
680 000 FEET
665 000 FEET
540 000 FEET
GILA
RIVER
64E AVENUE
SANITARY LANDFILL
Scale 1:24 000
2 Miles
1
0
¼
½
¾
10 000 Feet
5 000 Feet
1 000
2 000
3 000
4 000
5 000
14
13
16
21
31
12
7
13
18


49
R. 12 W.
R. 11 W.
(Joins sheet 42)
570 000 FEET
680 000 FEET
N
T. 6 S.
T. 7 S.
(Joins sheet 48)
(Joins sheet 50)
(Joins sheet 60)
665 000 FEET
600 000 FEET
Ten mile Wash
Aztec
SOUTHERN PACIFIC
8
80
16
21
7
13
11
31
22
9 10
16 15
2 Miles
1
0
10 000 Feet
5 000 Feet
Scale 1:24 000

YUMA — WELLTON AREA, ARIZONA — CALIFORNIA, PARTS OF YUMA COUNTY, ARIZONA AND IMPERIAL COUNTY, CALIFORNIA — SHEET NUMBER 50

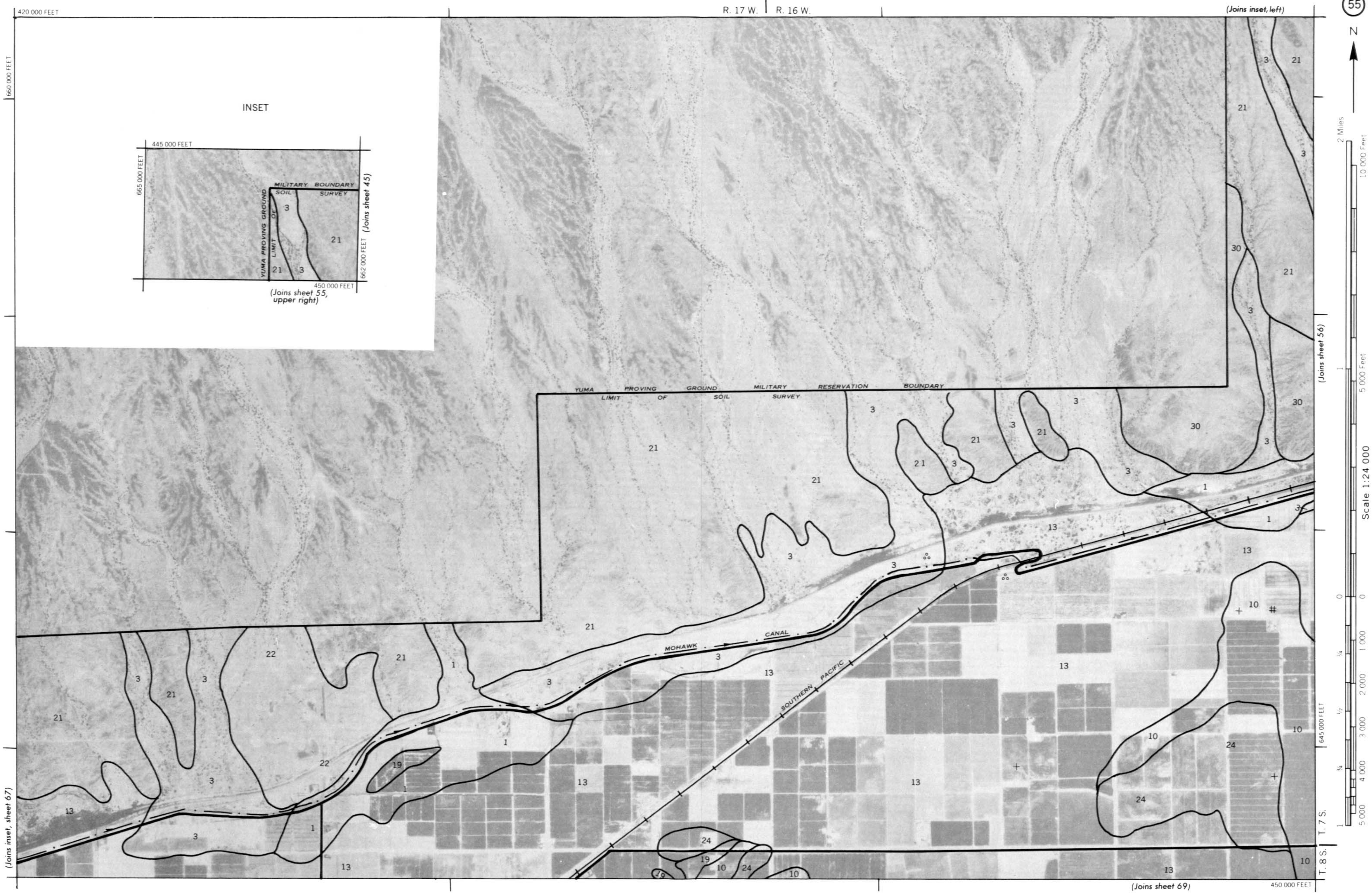


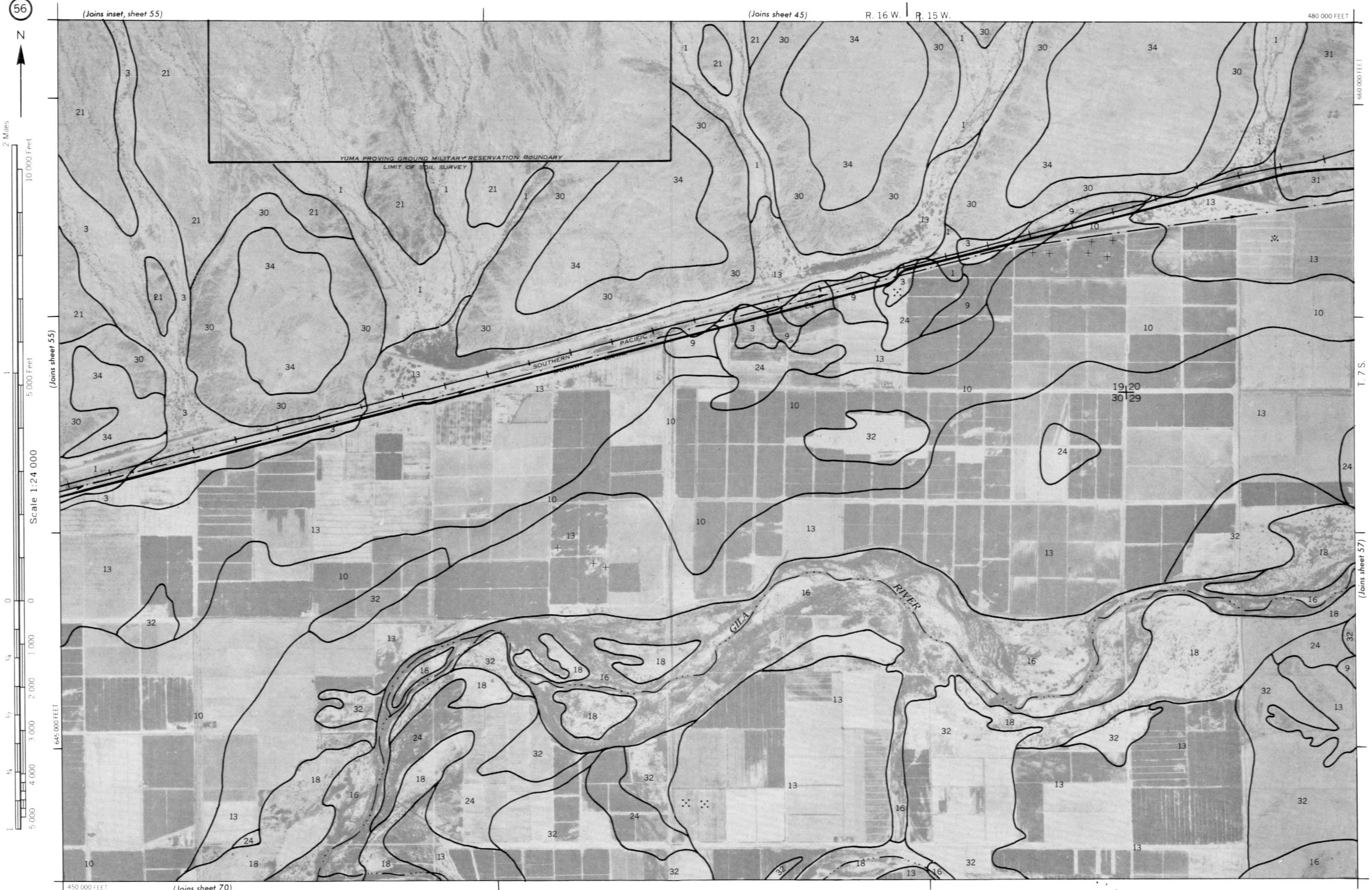

51
N
210 000 FEET
R. 22 E.
660 000 FEET
INSET
245 000 FEET
R. 23 W.
R. 22 W.
668 000 FEET
ALL AMERICAN CANAL
LIMIT OF SOIL SURVEY
T. 15 S.
(Joins sheet 44)
RESERVATION MAIN CANAL
COUNTY 11TH STREET
662 000 FEET
(Joins sheet 52)
260 000 FEET
3000 AND 5000-FOOT GRID TICKS
T. 15 S.
T. 16 S.
(Joins sheet 52)
LIMIT OF SOIL SURVEY
ALL AMERICAN CANAL
YUMA INDIAN RESERVATION
YUMA MAIN CANAL
RESERVATION MAIN DRAIN
645 000 FEET
(Joins sheet 62)
240 000 FEET
Scale 1:24 000
2 Miles
10 000 Feet
5 000 Feet

52
N
R. 22 W.
R. 23 W.
(Joins sheet 51)
(Joins sheet 44)
(Joins sheet 53)
(Joins sheet 63)
270 000 FEET
660 000 FEET
645 000 FEET
240 000 FEET
T. 6 S.
T. 7 S.
T. 8 S.
2 Miles
10 000 Feet
5 000 Feet
Scale 1:24 000
ALL AMERICAN CANAL
LIMIT OF SOIL SURVEY
FORT YUMA INDIAN RESERVATION
BOUNDARY
RESERVATION
FORT YUMA INDIAN RESERVATION
MAIN CANAL
COCOPAH CANAL
C AVENUE
Bard
Ross Corner
COUNTY 6TH STREET
RESERVATION MAIN CANAL
MOHAVE LATERAL
COLORADO RIVER
IMPERIAL COUNTY
YUMA COUNTY
CALIFORNIA
ARIZONA
WEST CANAL
AVENUE 7E
GILA MAIN CANAL
water

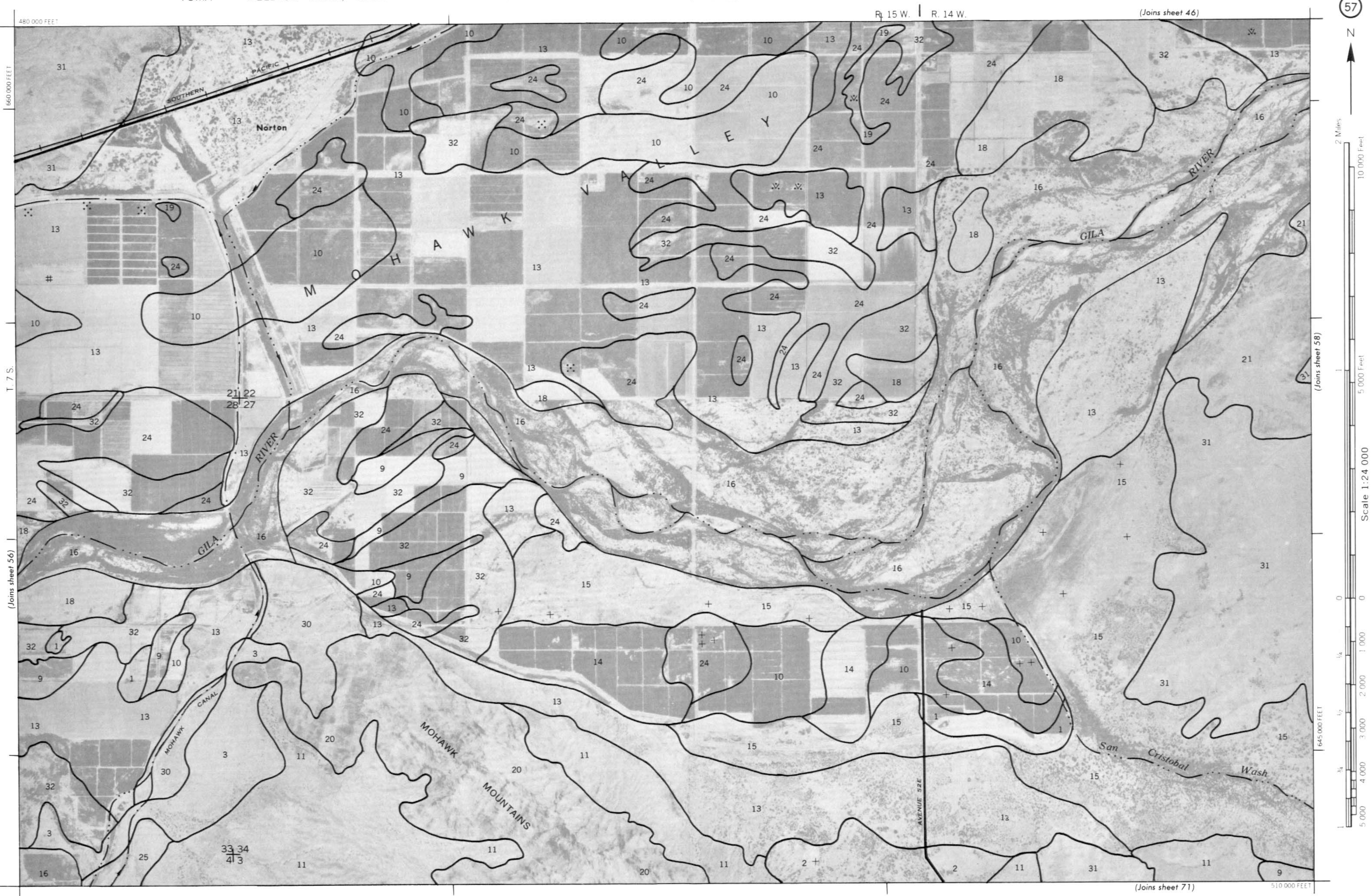

53
N
270 000 FEET
R. 22 W. | R. 21 W.
(Joins sheet 44)
560 000 FEET
water
water
water
24
17
24
13
18
10
20
20
20
30
CANAL
30
3
MAIN
3
30
GILA
30
3
30
20
20
MOUNTAINS
LAGUNA
30
(Joins sheet 52)
20
20
20
30
T. 7 S.
T. 8 S.
GILA
MAIN
CANAL
30
30
20
20
20
LIMIT OF SOIL SURVEY
31 | 32
6 | 5
32 | 33
5 | 4
LIMIT OF SOIL SURVEY
1
13
20
20
10
30
CANAL
1
13
20
DOME
10
95
20
13
13
11
(Joins sheet 54)
(Joins sheet 64)
545 000 FEET
300 000 FEET
2 Miles
10 000 Feet
1
5 000 Feet
Scale 1:24 000
0
0
1 000
2 000
3 000
4 000
5 000
¼
½
¾
1


54
N
Scale 1:24 000
R. 21 W.
R. 20 W.
YUMA PROVING GROUND
LIMIT OF SOIL MILITARY SURVEY BOUNDARY
DOME CANAL
GILA RIVER
95
30 29
31 32
T. 7 S.
T. 8 S.
(Joins sheet 53)
(Joins sheet 65)

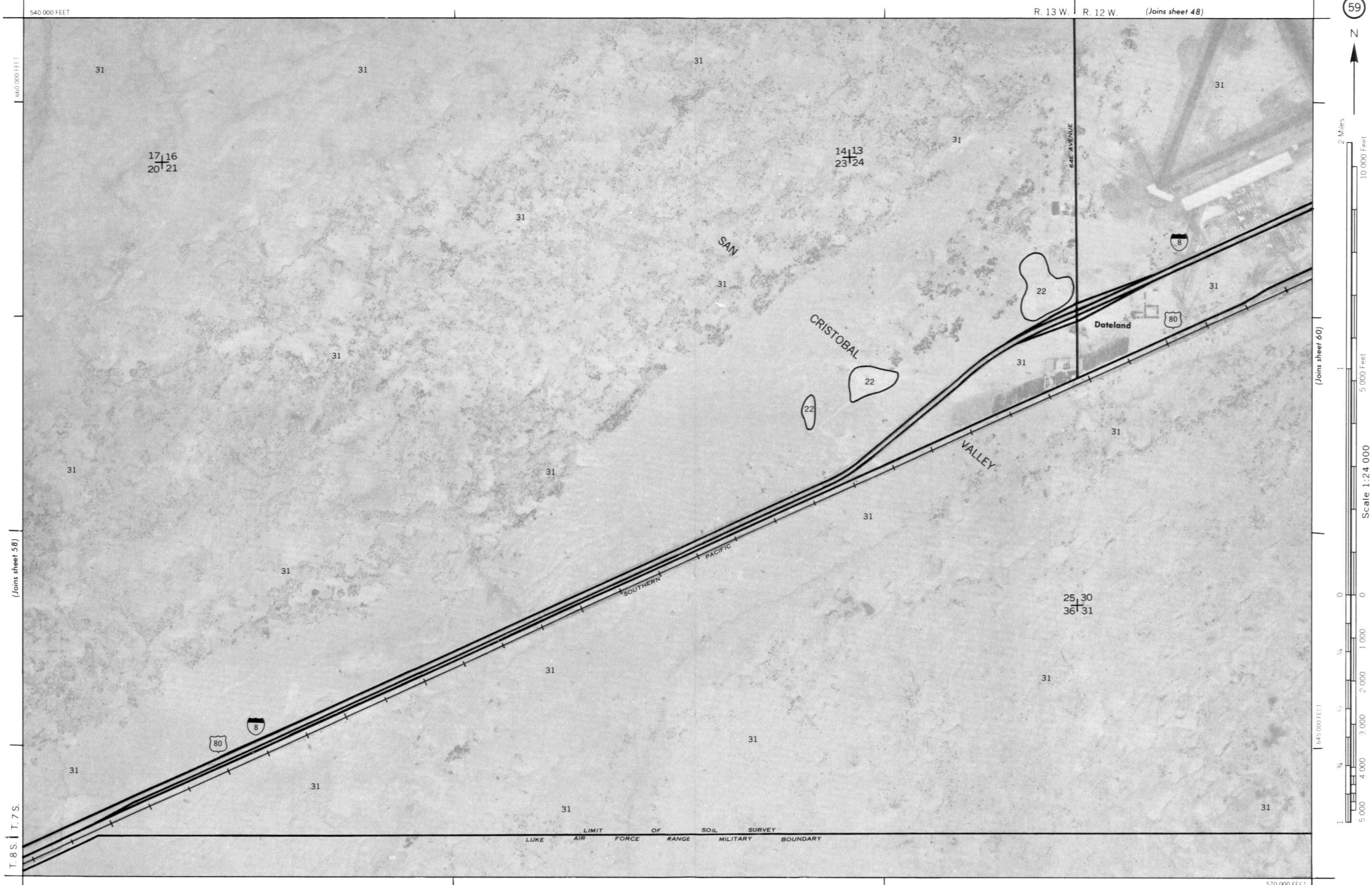

55
N
R. 17 W.
R. 16 W.
420 000 FEET
660 000 FEET
(Joins inset, left)
INSET
445 000 FEET
665 000 FEET
MILITARY BOUNDARY
SOIL SURVEY
YUMA PROVING GROUND
OF
LIMIT
(Joins sheet 45)
662 000 FEET
450 000 FEET
(Joins sheet 55, upper right)
YUMA PROVING GROUND MILITARY RESERVATION BOUNDARY
LIMIT OF SOIL SURVEY
MOHAWK CANAL
SOUTHERN PACIFIC
(Joins sheet 56)
(Joins inset, sheet 67)
(Joins sheet 69)
645 000 FEET
450 000 FEET
T. 7 S.
T. 8 S.
Scale 1:24 000
2 Miles
1
0
¼
½
¾
10 000 Feet
5 000 Feet
0
1 000
2 000
3 000
4 000
5 000


56
N
(Joins inset, sheet 55)
(Joins sheet 45)
R. 16 W.
R. 15 W.
480 000 FEET
660 000 FEET
YUMA PROVING GROUND MILITARY RESERVATION BOUNDARY
LIMIT OF SOIL SURVEY
SOUTHERN PACIFIC
GILA RIVER
(Joins sheet 55)
(Joins sheet 57)
(Joins sheet 70)
T. 7 S.
19 20
30 29
645 000 FEET
450 000 FEET
Scale 1:24 000
2 Miles
1
0
10 000 Feet
5 000 Feet
0
1 000
2 000
3 000
4 000
5 000
1/4
1/2
3/4
1

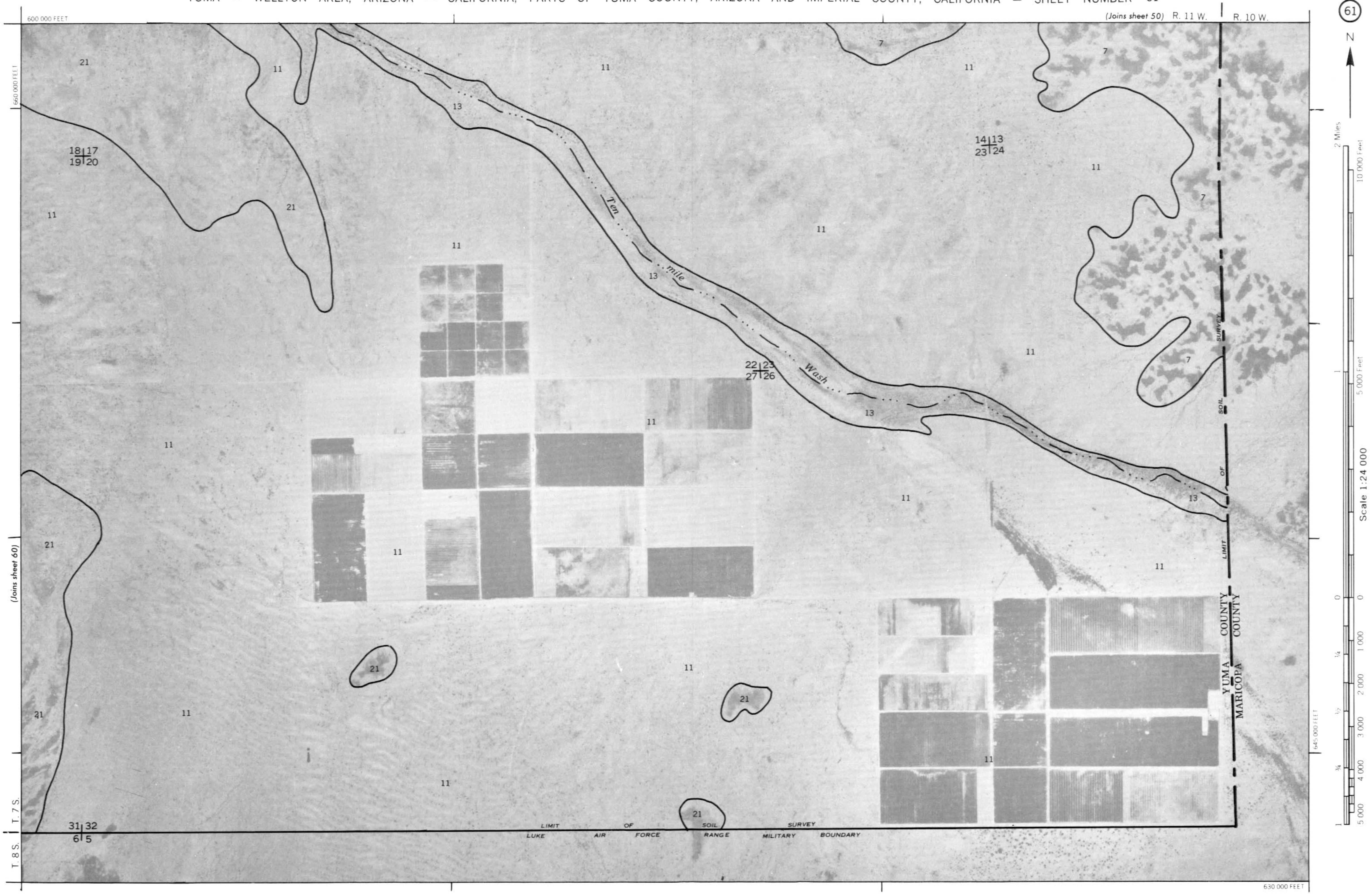
YUMA — WELLTON AREA, ARIZONA — CALIFORNIA, PARTS OF YUMA COUNTY, ARIZONA AND IMPERIAL COUNTY, CALIFORNIA — SHEET NUMBER 57



YUMA — WELLTON AREA, ARIZONA — CALIFORNIA, PARTS OF YUMA COUNTY, ARIZONA AND IMPERIAL COUNTY, CALIFORNIA — SHEET NUMBER 58


59
540 000 FEET
R. 13 W.
R. 12 W.
(Joins sheet 48)
(Joins sheet 58)
(Joins sheet 60)
660 000 FEET
645 000 FEET
570 000 FEET
N
SAN
CRISTOBAL
VALLEY
Dateland
64E AVENUE
SOUTHERN
PACIFIC
8
80
22
31
17 16
20 21
14 13
23 24
25 30
36 31
T. 7 S.
T. 8 S.
LIMIT OF SOIL SURVEY
LUKE AIR FORCE RANGE MILITARY BOUNDARY
Scale 1:24 000
2 Miles
10 000 Feet
5 000 Feet
1
¾
½
¼
0
1 000
2 000
3 000
4 000
5 000


60
N
(Joins sheet 49)
(Joins sheet 59)
(Joins sheet 61)
R. 12 W.
R. 11 W.
R. 11½ W.
T. 7 S.
T. 8 S.
600 000 FEET
660 000 FEET
645 000 FEET
570 000 FEET
8
80
SOUTHERN PACIFIC
AZTEX HILLS
WHITE MOUNTAIN
SAN CRISTOBAL VALLEY
LUKE AIR FORCE RANGE MILITARY BOUNDARY
LIMIT OF SOIL SURVEY
Scale 1:24 000
2 Miles
10 000 Feet
5 000 Feet
1
½
¼
¾
0
1 000
2 000
3 000
4 000
5 000



61
N
(Joins sheet 50)
R. 11 W.
R. 10 W.
(Joins sheet 60)
600 000 FEET
660 000 FEET
645 000 FEET
630 000 FEET
T. 7 S.
T. 8 S.
Ten mile Wash
SOIL SURVEY LIMIT
LIMIT OF SOIL SURVEY
LUKE AIR FORCE RANGE MILITARY BOUNDARY
YUMA COUNTY
MARICOPA COUNTY
Scale 1:24 000
2 Miles
10 000 Feet

YUMA — WELLTON AREA, ARIZONA — CALIFORNIA, PARTS OF YUMA COUNTY, ARIZONA AND IMPERIAL COUNTY, CALIFORNIA — SHEET NUMBER 62


(Joins sheet 52)
(Joins sheet 62)
(Joins sheet 64)
(Joins sheet 75)
240 000 FEET
640 000 FEET
625 000 FEET
270 000 FEET
R. 23 W.
R. 22 W.
T. 8 S.
COLORADO RIVER
GILA RIVER
COCOPAH CANAL
IMPERIAL COUNTY
YUMA COUNTY
CALIFORNIA
ARIZONA
AVENUE 4E
AVENUE 7E
8TH STREET COUNTY
MAIN OUTLET DRAIN
N
63
Scale 1:24 000
2 Miles
1
0
10 000 Feet
5 000 Feet
0
1 000
2 000
3 000
4 000
5 000


(Joins sheet 53)
R. 22 W.
R. 21 W.
300 000 FEET
640 000 FEET
N
2 Miles
10 000 Feet
5 000 Feet
Scale 1:24 000
(Joins sheet 63)
(Joins sheet 65)
(Joins sheet 76)
270 000 FEET
625 000 FEET
T. 8 S.
LAKE HIKE
GILA MAIN CANAL
GILA RIVER
WELLTON-MOHAWK CANAL
SOUTHERN PACIFIC
MAIN OUTLET DRAIN
Fortuna Wash
MILITARY RESERVATION
NATIONAL GUARD RIFLE RANGE
PROVING GROUND
BOUNDARY
YUMA


65
N
R. 21 W.
R. 20 W.
(Joins sheet 54)
(Joins sheet 64)
(Joins sheet 66)
(Joins sheet 77)
T. 8 S.
300 000 FEET
640 000 FEET
625 000 FEET
330 000 FEET
GILA RIVER
WELLTON-MOHAWK CANAL
SOUTHERN PACIFIC
Dome
DOME CANAL
YUMA PROVING GROUND MILITARY RES BOY
LIMIT OF SOIL SURVEY
GILA MOUNTAINS
NATIONAL GUARD RIFLE RANGE
Scale 1:24 000
2 Miles
10 000 Feet
5 000 Feet


R. 19 W.
360 000 FEET
640 000 FEET
T. 8 S.
625 000 FEET
330 000 FEET
N
Scale 1:24 000
2 Miles
1
0
¼
½
¾
1
10 000 Feet
5 000 Feet
0
1 000
2 000
3 000
4 000
5 000
(Joins sheet 65)
(Joins sheet 78)
YUMA PROVING GROUND
MILITARY RESERVATION BOUNDARY
LIMIT OF SOIL SURVEY
SANITARY LANDFILL
AVENUE 20E
21
3
21
3
3
21
3
13
21
3
21
13
13
19
21
3
21
19
13
20
24
13
18
24
13
24
19
20
20
20
14
21
13
10
24
13


67
N
390 000 FEET
R. 18 W.
R. 17 W.
648 000 FEET
T. 8 S.
YUMA PROVING GROUND LIMIT OF SOIL SURVEY MILITARY RESERVATION BOUNDARY
21
3
32 33
5 4
13
(Joins sheet 55)
642 000 FEET
(Joins sheet 68)
420 000 FEET
360 000 FEET
R. 19 W.
R. 18 W.
630 000 FEET
T. 8 S.
24 19
16
18
19
24
32
GILA RIVER
(Joins sheet 68)
625 000 FEET
(Joins sheet 79)
390 000 FEET
2 Miles
10 000 Feet
1
5 000 Feet
0
Scale 1:24 000


68
N
(Joins inset, sheet 67)
R. 18 W.
R. 17 W.
420 000 FEET
640 000 FEET
T. 8 S.
(Joins sheet 67)
(Joins sheet 69)
(Joins sheet 80)
390 000 FEET
625 000 FEET
YUMA PROVING GROUND MILITARY RES BDY
LIMIT OF SOIL SURVEY
GILA RIVER
WELLTON CANAL
MOHAWK CANAL
AVENUE 34E
AVENUE 36E
SOUTHERN PACIFIC
ANTELOPE HILL
Scale 1:24 000
2 Miles
1
0
10 000 Feet
5 000 Feet
0
1 000
2 000
3 000
4 000
5 000
¼
½
¾


69
(Joins sheet 55)
(Joins sheet 68)
(Joins sheet 70)
(Joins sheet 81)
420 000 FEET
640 000 FEET
625 000 FEET
445 000 FEET
R. 17 W.
R. 16 W.
T. 8 S.
Roll
SOUTHERN PACIFIC
WELLTON—MOHAWK CANAL
GILA RIVER
N
Scale 1:24 000
2 Miles
10 000 Feet
1
5 000 Feet
0
0
¼
1 000
2 000
½
3 000
¾
4 000
5 000


70
N
2 Miles
10 000 Feet
5 000 Feet
1
0
1/4
1/2
3/4
1 000
2 000
3 000
4 000
5 000
Scale 1:24 000
(Joins sheet 56)
R. 16 W.
R. 15 W.
480 000 FEET
640 000 FEET
T. 8 S.
(Joins sheet 69)
(Joins sheet 71)
(Joins sheet 82)
450 000 FEET
625 000 FEET
GILA
RIVER
MOHAWK
CANAL
SOUTHERN
PACIFIC
80
8

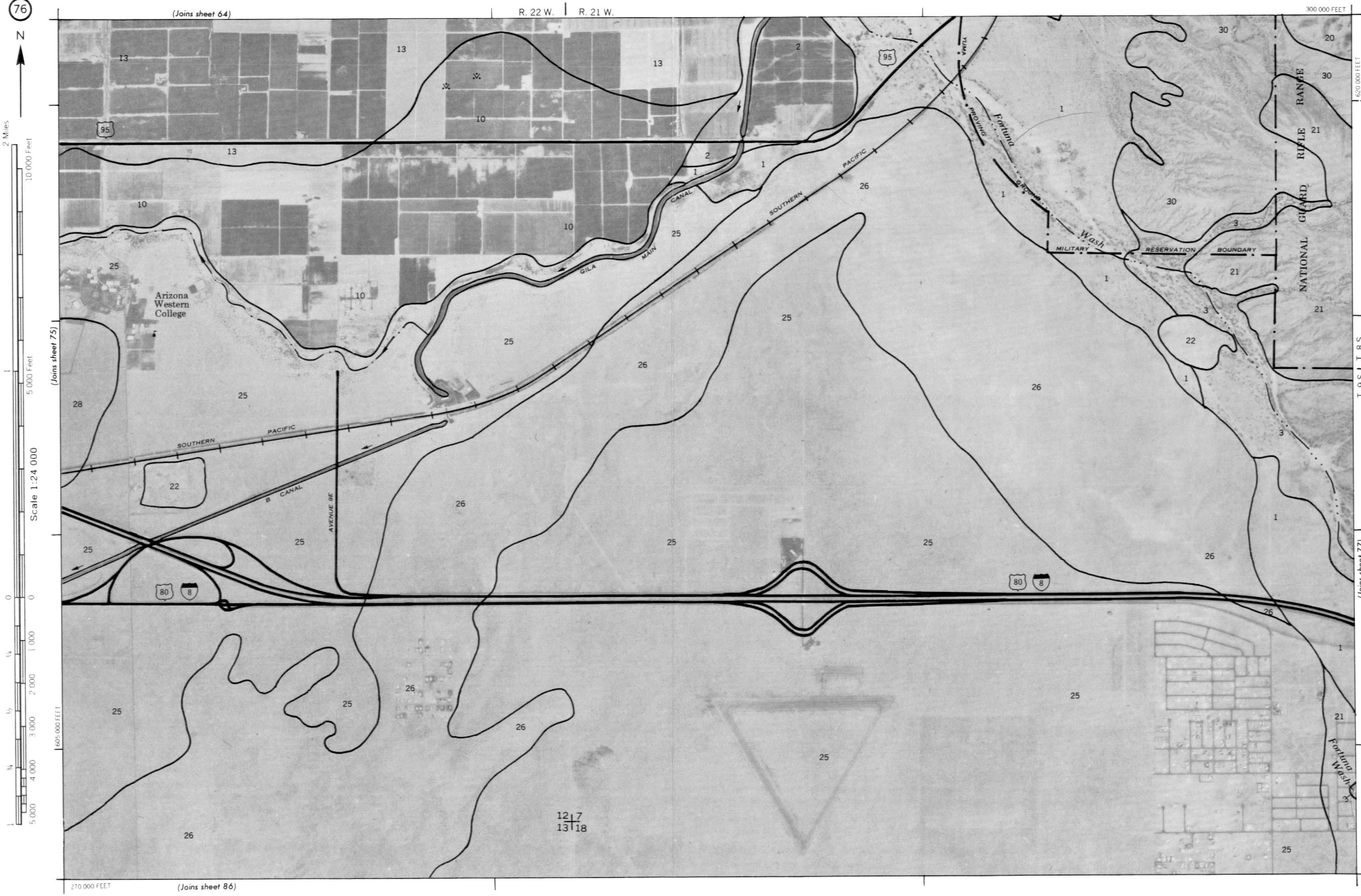

71
480 000 FEET
640 000 FEET
R. 15 W.
R. 14 W.
(Joins sheet 57)
(Joins sheet 70)
(Joins sheet 72)
(Joins inset, sheet 72)
T. 8 S.
625 000 FEET
510 000 FEET
N
MOHAWK MOUNTAINS
MOHAWK
CANAL
AVENUE 52E
SOUTHERN PACIFIC
LIMIT OF SOIL SURVEY
Scale 1:24 000
2 Miles
10 000 Feet
5 000 Feet
0
1000
2000
3000
4000
5000
80
8
22


72
N
Scale 1:24 000
2 Miles
10 000 Feet
5 000 Feet
(Joins sheet 58)
R. 14 W.
R. 13 W.
540 000 FEET
640 000 FEET
T. 8 S.
San Cristobal Wash
15
9
11
31
22
8
SOUTHERN PACIFIC
LUKE AIR FORCE RANGE MILITARY BOUNDARY
LIMIT OF SOIL SURVEY
625 000 FEET
510 000 FEET
INSET
(Joins sheet 71)
(Joins sheet 82)
R. 14 W.
500 000 FEET
620 000 FEET
615 000 FEET
480 000 FEET
2
25
11
20
21
28 27
33 34
27 26
34 35
26 25
35 36
LIMIT OF SOIL SURVEY
LUKE AIR FORCE RANGE MILITARY BOUNDARY


73
180 000 FEET
R. 24 W.
(Joins inset, sheet 24)
INSET
175 000 FEET
R. 25 W.
590 000 FEET
COLORADO RIVER
LIMIT OF SOIL SURVEY
ARIZONA
CALIFORNIA
BAJA CALIFORNIA
YUMA COUNTY
(Joins sheet 83)
585 000 FEET
T. 9 S.
T. 10 S.
(Joins sheet 91)
180 000 FEET
SOUTHERN PACIFIC
MEXICO
CANAL
COUNTY 11TH STREET
MAIN DRAIN
SOMERTON AVENUE
WEST MAIN CANAL
NORTH DRAIN
T. 8 S.
(Joins sheet 74)
605 000 FEET
(Joins sheet 83)
210 000 FEET
N
Scale 1:24 000
2 Miles
10 000 Feet
5 000 Feet


74
N
(Joins sheet 62)
R. 24 W.
R. 23 W.
240 000 FEET
620 000 FEET
(Joins sheet 73)
(Joins sheet 75)
(Joins sheet 84)
210 000 FEET
605 000 FEET
T. 8 S.
T. 9 S.
YUMA
AVENUE D
AVENUE C
AVENUE B
AVENUE A
4TH AVENUE
COUNTY 32ND STREET
EAST MAIN CANAL
SOUTHERN PACIFIC
YUMA INTERNATIONAL AIRPORT
U.S. MARINE CORPS AIR STATION
MAIN SUPPLY CANAL
95
80
2 Miles
10 000 Feet
5 000 Feet
1
0
Scale 1:24 000
1 000
2 000
3 000
4 000
5 000


75
(Joins sheet 63)
(Joins sheet 74)
(Joins sheet 76)
(Joins sheet 85)
240 000 FEET
270 000 FEET
620 000 FEET
605 000 FEET
R. 23 W.
R. 22 W.
T. 8 S.
T. 9 S.
N
YUMA
U.S. MARINE CORPS
AIR STATION
AVENUE 3E
AVENUE 4E
AVENUE 7E
SOUTH GILA VALLEY MAIN CANAL
SOUTHERN PACIFIC
B CANAL
A CANAL
95
8
80
35 36
2 1
Scale 1:24 000
2 Miles
1
0
10 000 Feet
5 000 Feet
5 000
1 000
2 000
3 000
4 000


76
N
(Joins sheet 64)
R. 22 W.
R. 21 W.
300 000 FEET
620 000 FEET
(Joins sheet 75)
(Joins sheet 77)
(Joins sheet 86)
270 000 FEET
605 000 FEET
T. 8 S.
T. 9 S.
Scale 1:24 000
2 Miles
1
0
10 000 Feet
5 000 Feet
Arizona
Western
College
SOUTHERN PACIFIC
GILA MAIN CANAL
B CANAL
AVENUE 9E
YUMA PROVING GROUND
Fortuna Wash
MILITARY RESERVATION BOUNDARY
NATIONAL GUARD RIFLE RANGE
95
80
8
12 7
13 18

YUMA — WELLTON AREA, ARIZONA — CALIFORNIA, PARTS OF YUMA COUNTY, ARIZONA AND IMPERIAL COUNTY, CALIFORNIA — SHEET NUMBER 77

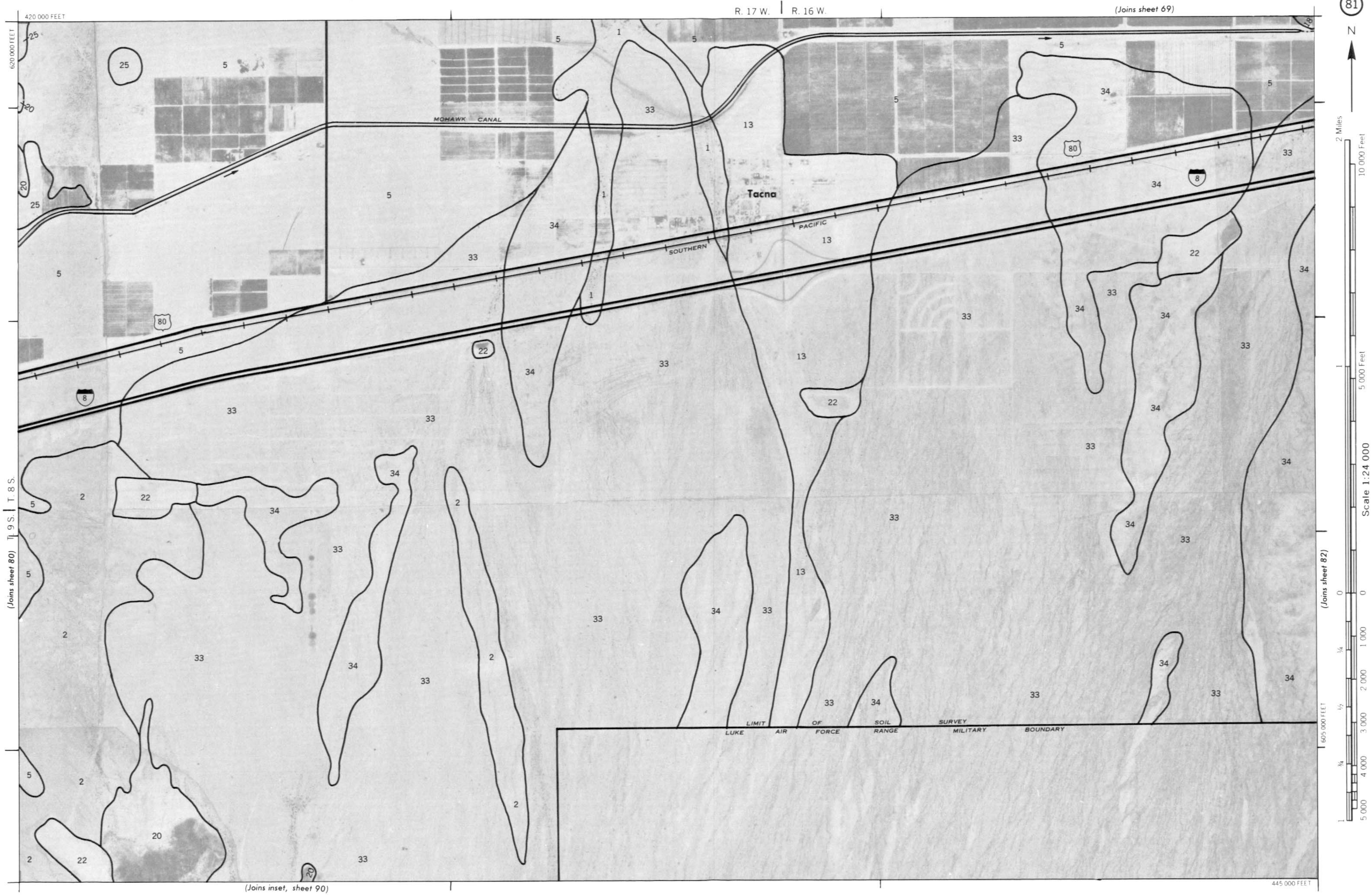

78
N
2 Miles
10 000 Feet
5 000 Feet
Scale 1:24 000
(Joins sheet 66)
R. 19 W.
360 000 FEET
620 000 FEET
(Joins sheet 77)
(Joins sheet 79)
(Joins sheet 88)
330 000 FEET
605 000 FEET
T. 8 S.
T. 9 S.
YUMA PROVING GROUND LIMIT
MILITARY RESERVATION BOUNDARY OF SOIL SURVEY
GILA RIVER
WELLTON-MOHAWK CANAL
SOUTHERN PACIFIC
AVENUE 20E
80
8


79
(Joins sheet 67)
(Joins sheet 78)
(Joins sheet 80)
(Joins sheet 89)
R. 19 W.
R. 18 W.
T. 8 S.
T. 9 S.
360 000 FEET
620 000 FEET
605 000 FEET
390 000 FEET
MILITARY
RESERVATION
BOUNDARY
SOIL
SURVEY
GROUND
OF
YUMA
PROVING
LIMIT
GILA
RIVER
MOHAWK
CHANNEL
WELLTON
Wellton
SOUTHERN
PACIFIC
WELLTON
CANAL
80
8
N
Scale 1:24 000
2 Miles
10 000 Feet
5 000 Feet
1 000
2 000
3 000
4 000
5 000

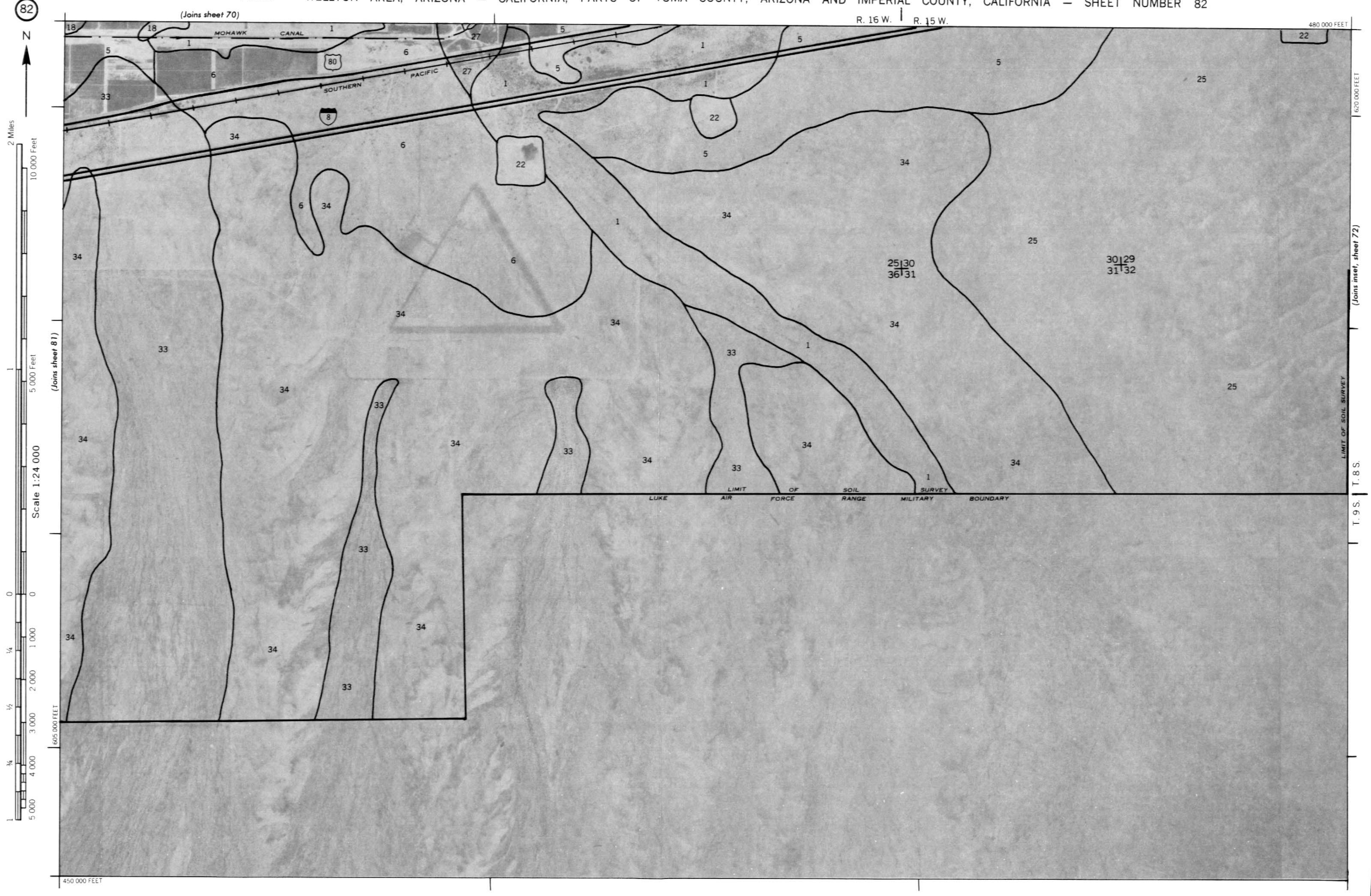

80
N
(Joins sheet 68)
(Joins sheet 79)
(Joins sheet 81)
(Joins sheet 90)
R. 18 W.
R. 17 W.
T. 8 S.
T. 9 S.
420 000 FEET
620 000 FEET
605 000 FEET
390 000 FEET
GILA RIVER
ANTELOPE HILL
SOUTHERN PACIFIC
WELLTON CANAL
MOHAWK CANAL
Scale 1:24 000
2 Miles
10 000 Feet
5 000 Feet

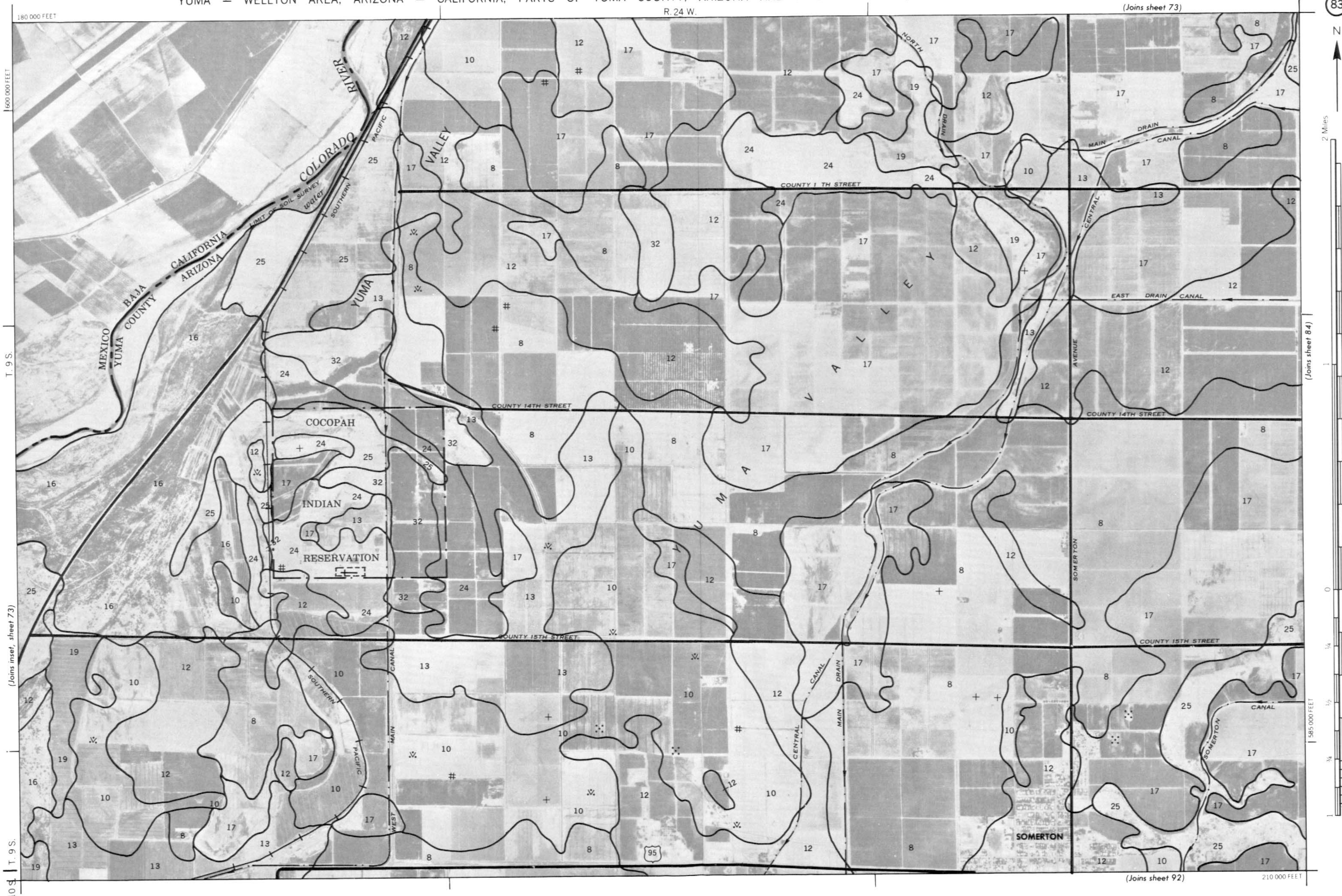
YUMA — WELLTON AREA, ARIZONA — CALIFORNIA, PARTS OF YUMA COUNTY, ARIZONA AND IMPERIAL COUNTY, CALIFORNIA — SHEET NUMBER 81

81

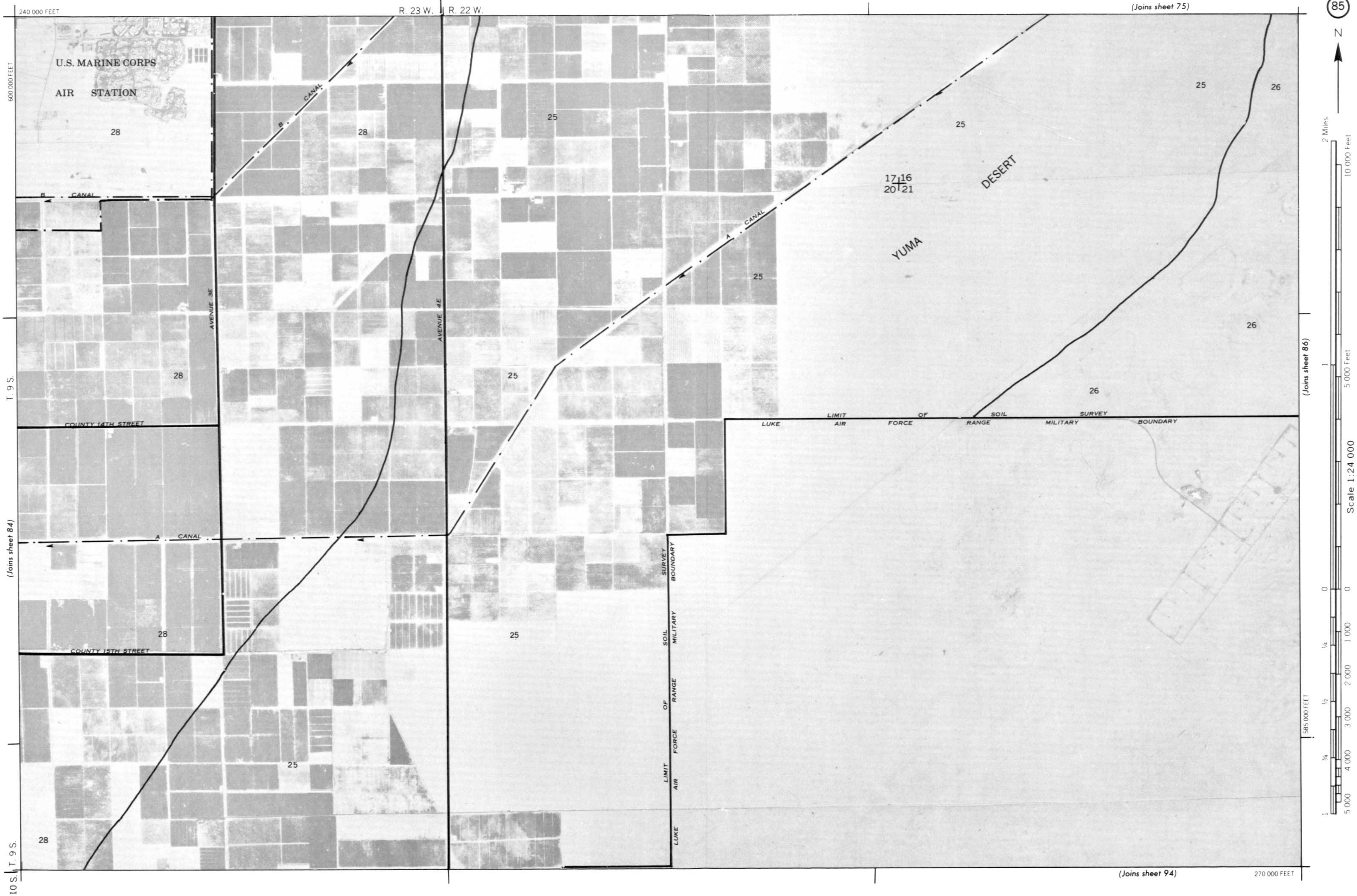


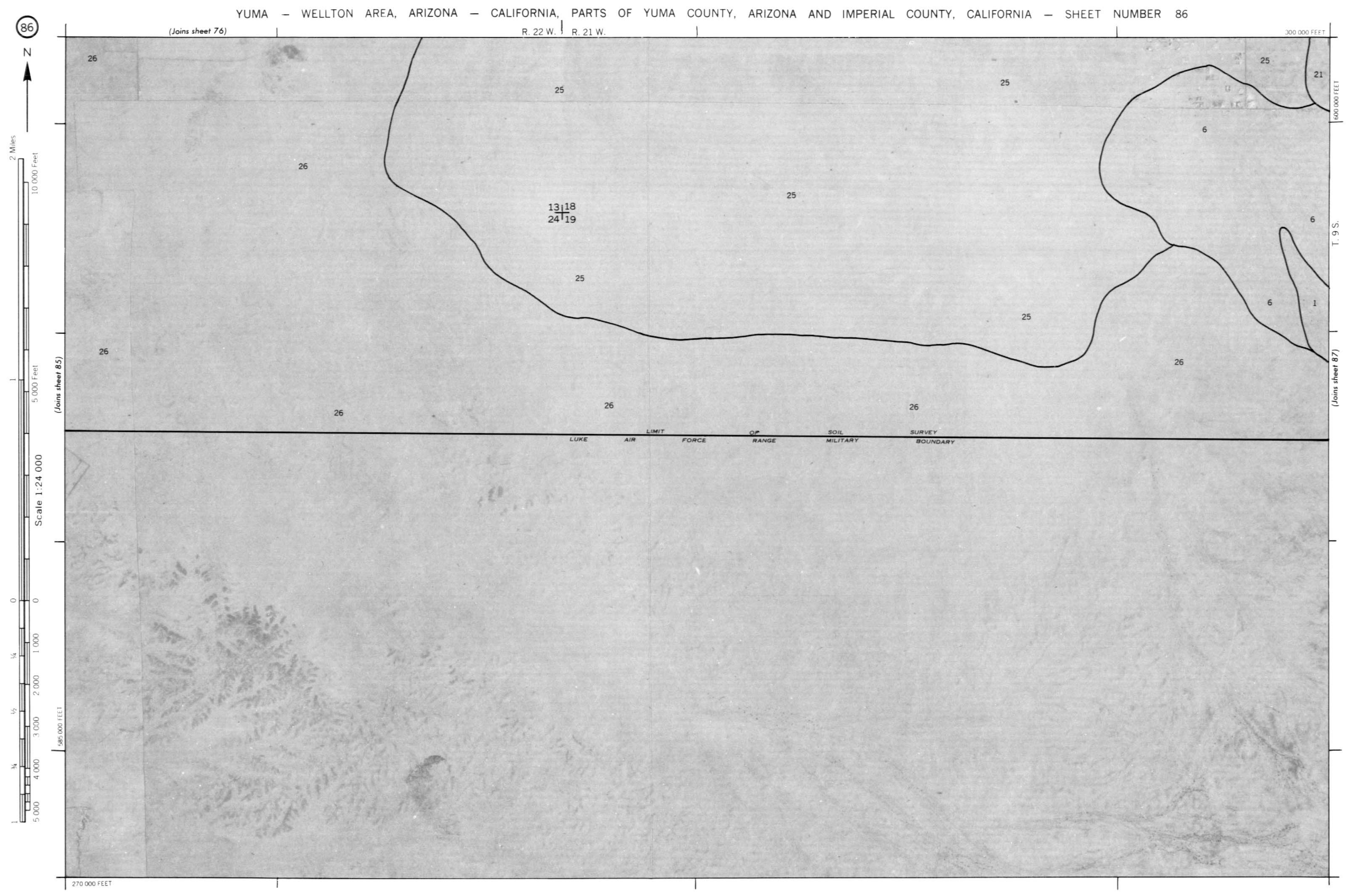
YUMA — WELLTON AREA, ARIZONA — CALIFORNIA, PARTS OF YUMA COUNTY, ARIZONA AND IMPERIAL COUNTY, CALIFORNIA — SHEET NUMBER 82




83
N
(Joins sheet 73)
R. 24 W.
180 000 FEET
600 000 FEET
T. 9 S.
T. 9 S.
10 S.
(Joins inset, sheet 73)
(Joins sheet 84)
(Joins sheet 92)
210 000 FEET
585 000 FEET
COLORADO RIVER
LIMIT OF SOIL SURVEY
water
CALIFORNIA
ARIZONA
BAJA CALIFORNIA
YUMA COUNTY
MEXICO
YUMA COUNTY
SOUTHERN PACIFIC
YUMA VALLEY
NORTH DRAIN
MAIN DRAIN CANAL
COUNTY 11TH STREET
CENTRAL CANAL
EAST DRAIN CANAL
COUNTY 14TH STREET
COUNTY 15TH STREET
COCOPAH INDIAN RESERVATION
SOMERTON AVENUE
MAIN CANAL
WEST MAIN CANAL
CENTRAL CANAL
MAIN DRAIN
CANAL
SOMERTON
SOMERTON
95
2 Miles
1
0
10 000 Feet
5 000 Feet
0
1 000
2 000
3 000
4 000
5 000
Scale 1:24 000

YUMA — WELLTON AREA, ARIZONA — CALIFORNIA, PARTS OF YUMA COUNTY, ARIZONA AND IMPERIAL COUNTY, CALIFORNIA — SHEET NUMBER 84


85
240 000 FEET
R. 23 W. | R. 22 W.
(Joins sheet 75)
600 000 FEET
U.S. MARINE CORPS
AIR STATION
28
B CANAL
28
25
25
25
26
17 16
20 21
DESERT
YUMA
A CANAL
25
26
AVENUE 3E
AVENUE 4E
28
25
26
T. 9 S.
COUNTY 14TH STREET
LUKE AIR FORCE RANGE LIMIT OF SOIL SURVEY MILITARY BOUNDARY
(Joins sheet 86)
(Joins sheet 84)
A CANAL
MILITARY BOUNDARY SURVEY SOIL RANGE OF FORCE LIMIT AIR LUKE
28
25
COUNTY 15TH STREET
25
28
T. 9 S.
T. 10 S.
(Joins sheet 94)
270 000 FEET
585 000 FEET
N
2 Miles
1
0
1/4
1/2
3/4
1
10 000 Feet
5 000 Feet
0
1 000
2 000
3 000
4 000
5 000
Scale 1:24 000

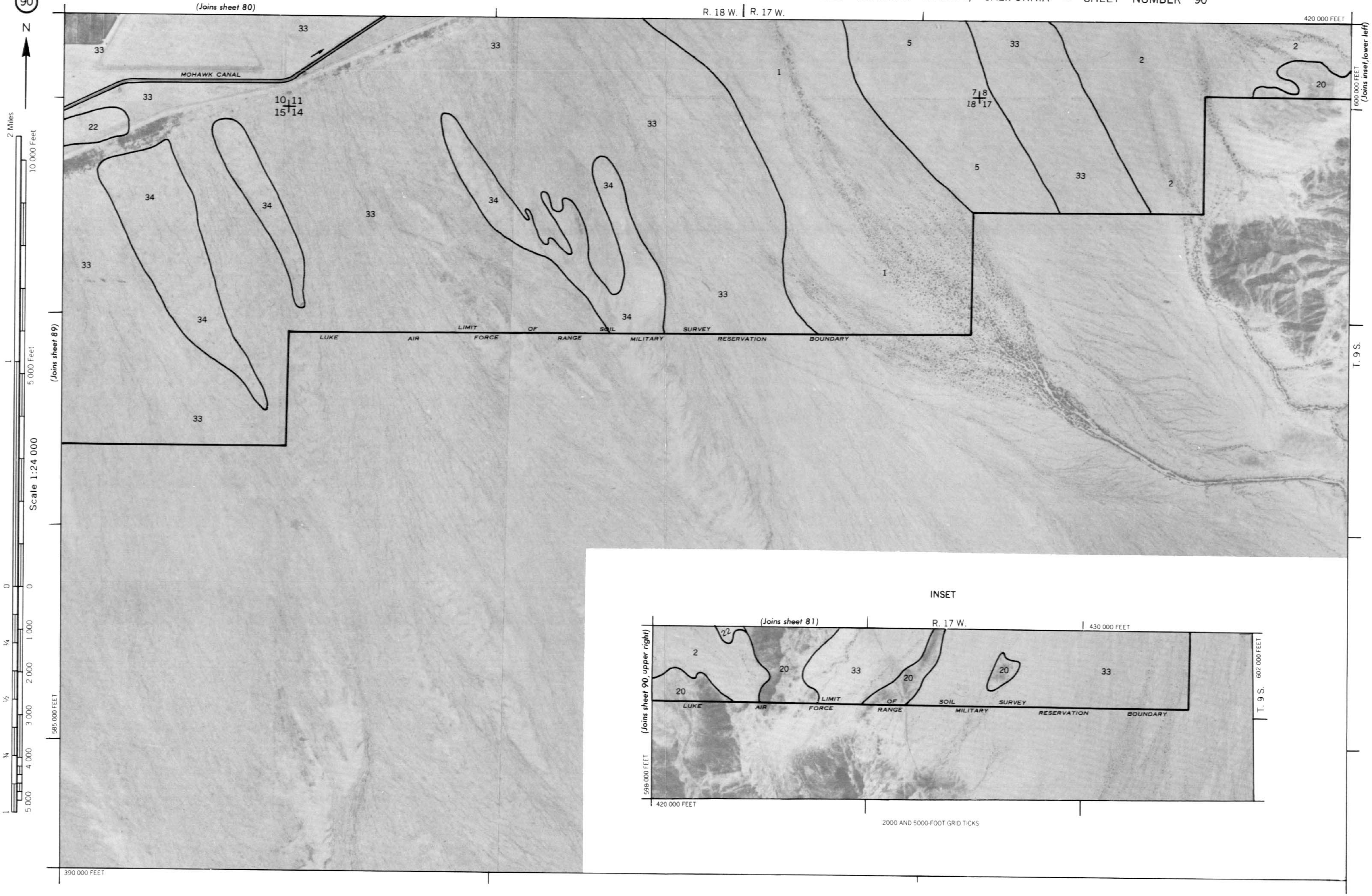

86
N
(Joins sheet 76)
R. 22 W.
R. 21 W.
300 000 FEET
600 000 FEET
T. 9 S.
(Joins sheet 85)
(Joins sheet 87)
26
25
21
6
1
13
18
24
19
LUKE AIR FORCE RANGE MILITARY BOUNDARY
LIMIT OF SOIL SURVEY
585 000 FEET
270 000 FEET
2 Miles
1
0
¼
½
¾
10 000 Feet
5 000 Feet
0
1 000
2 000
3 000
4 000
5 000
Scale 1:24 000

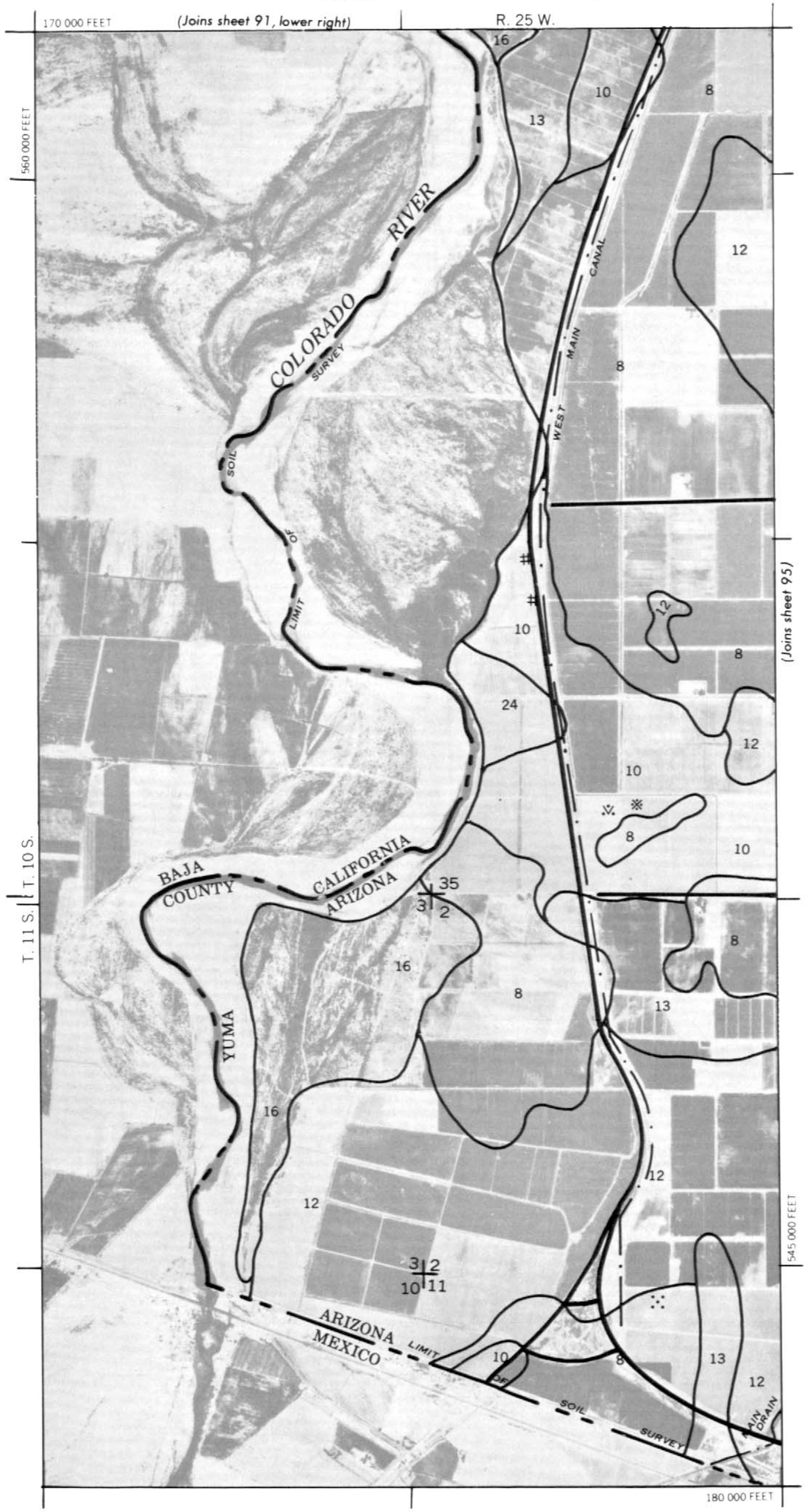

87
N
R. 21 W.
R. 20 W.
300 000 FEET
600 000 FEET
(Joins sheet 77)
(Joins sheet 86)
(Joins sheet 88)
T. 9 S.
Fortuna
Wash
15 14
22 23
GILA MOUNTAINS
LIMIT OF SOIL SURVEY
LUKE AIR FORCE RANGE MILITARY BOUNDARY
585 000 FEET
330 000 FEET
2 Miles
10 000 Feet
5 000 Feet
Scale 1:24 000
0
1 000
2 000
3 000
4 000
5 000
1
¼
½
¾


88
N
(Joins sheet 78)
R. 20 W.
R. 19 W.
360 000 FEET
600 000 FEET
WELLTON-MOHAWK CANAL
80
WELLTON CANAL
MOHAWK CANAL
T. 9 S.
(Joins sheet 87)
(Joins sheet 89)
13 18
24 19
21 22
LIMIT OF SOIL SURVEY
LUKE AIRFORCE RANGE MILITARY BOUNDARY
585 000 FEET
330 000 FEET
2 Miles
10 000 Feet
1
5 000 Feet
Scale 1:24 000
0
1 000
2 000
3 000
4 000
5 000
¼
½
¾


89
N
(Joins sheet 79)
(Joins sheet 88)
(Joins sheet 90)
R. 19 W.
R. 18 W.
T. 9 S.
360 000 FEET
600 000 FEET
585 000 FEET
390 000 FEET
WELLTON CANAL
MOHAWK CANAL
LIMIT OF SOIL SURVEY
AIR FORCE RANGE MILITARY BOUNDARY
11 12
14 13
13 18
24 19
22 23
23 24
24 19
19 20
Scale 1:24 000
2 Miles
1
0
10 000 Feet
5 000 Feet
0
1 000
2 000
3 000
4 000
5 000

YUMA — WELLTON AREA, ARIZONA — CALIFORNIA, PARTS OF YUMA COUNTY, ARIZONA AND IMPERIAL COUNTY, CALIFORNIA — SHEET NUMBER 90




170 000 FEET
(Joins sheet 91, lower right)
R. 25 W.
560 000 FEET
(Joins sheet 95)
545 000 FEET
180 000 FEET
T. 10 S.
T. 11 S.
COLORADO RIVER
SOIL SURVEY LIMIT
WEST MAIN CANAL
BAJA CALIFORNIA
YUMA COUNTY ARIZONA
ARIZONA MEXICO
MAIN DRAIN
35
3
2
3 2
10 11
16
10
13
8
12
24

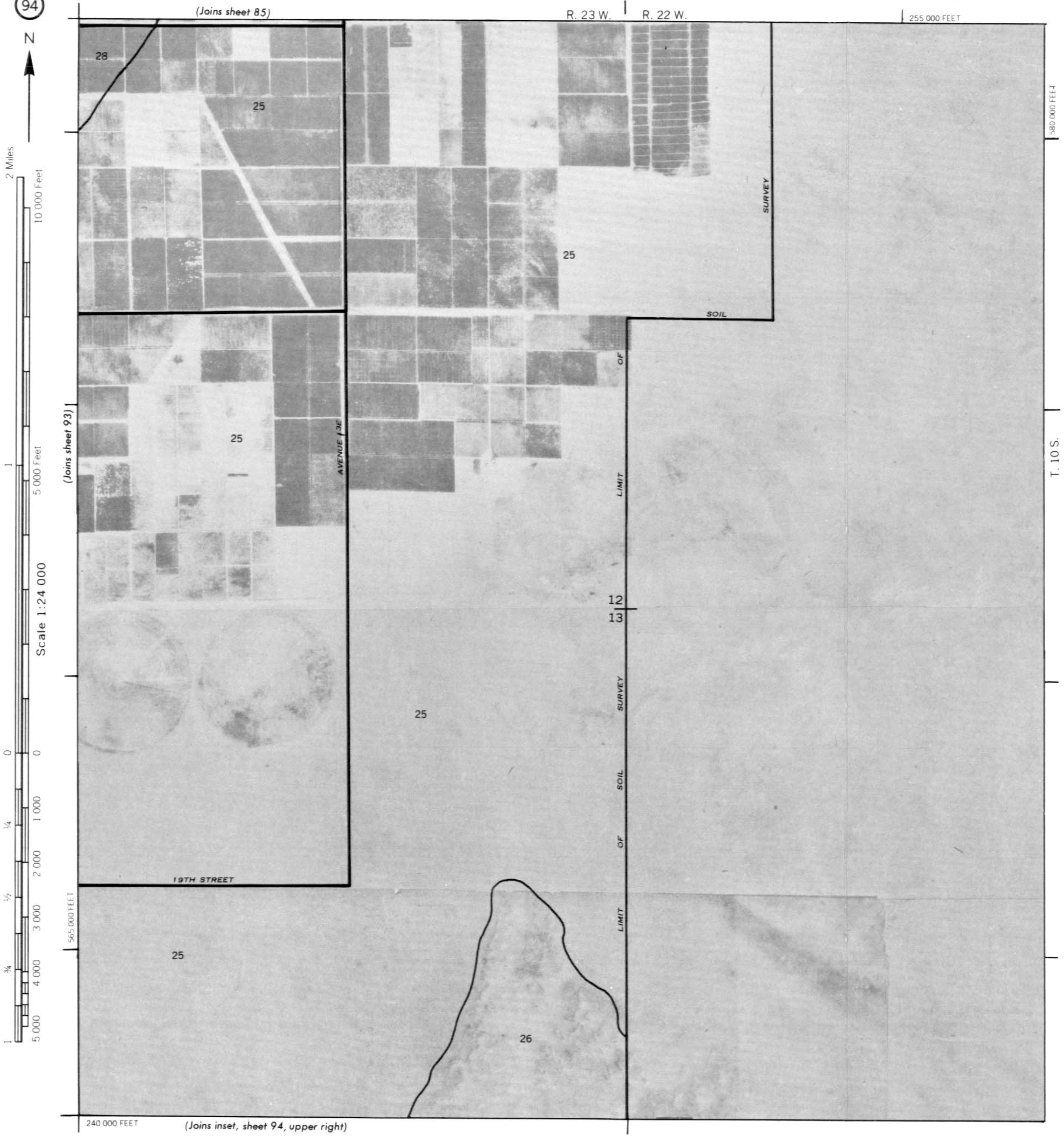

165 000 FEET
R. 25 W.
(Joins inset, sheet 73)
580 000 FEET
T. 10 S.
(Joins sheet 92)
565 000 FEET
180 000 FEET
(Joins inset, upper left)
COLORADO RIVER
BAJA CALIFORNIA
YUMA COUNTY
ARIZONA MEXICO
MEXICO ARIZONA
SOIL SURVEY LIMIT
SOUTHERN PACIFIC
WEST MAIN CANAL
24
25
19
8
12
13
16
10
N
2 Miles
1
0
10 000 Feet
5 000 Feet
1 000
2 000
3 000
4 000
5 000
Scale 1:24 000

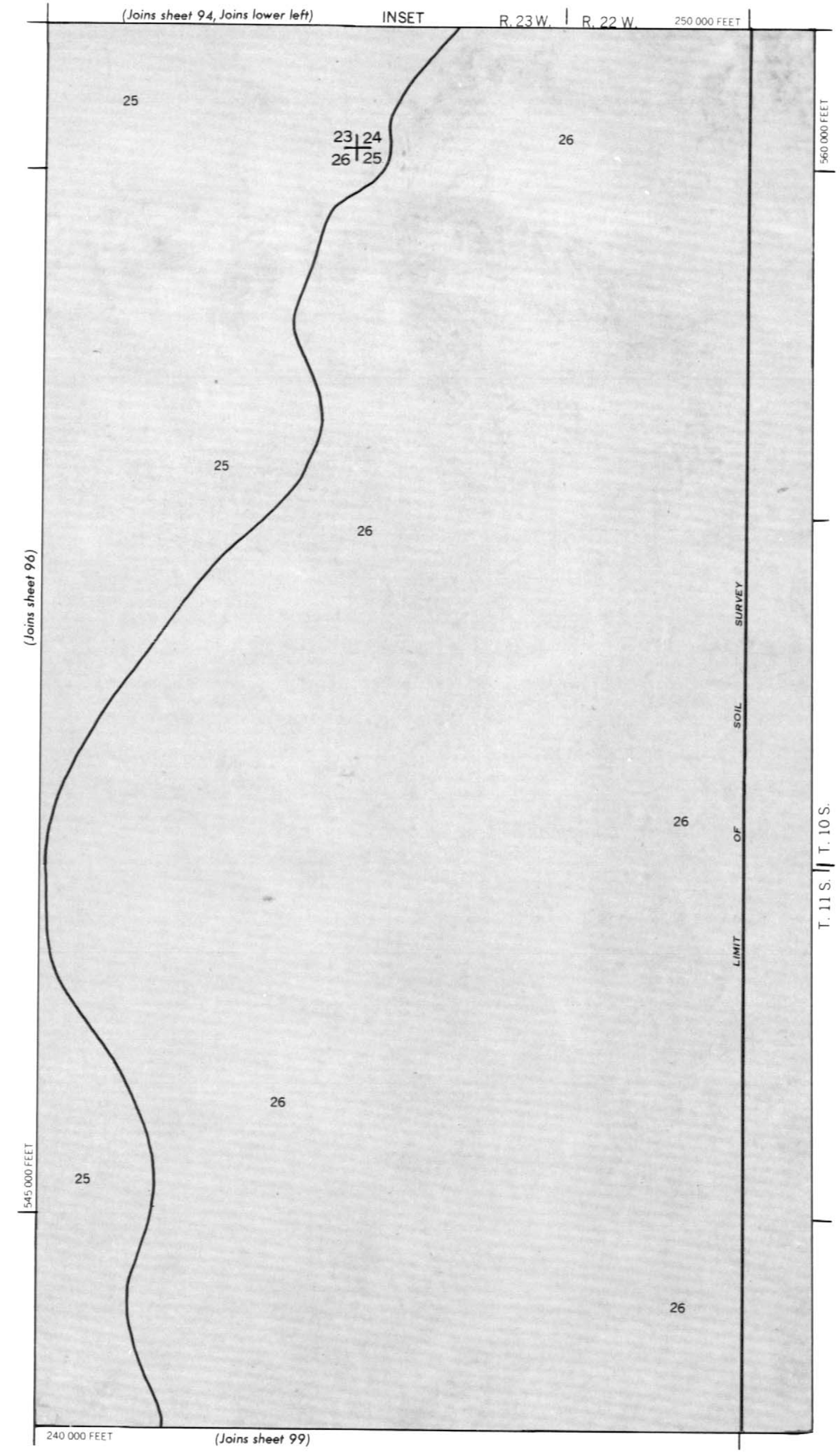
91

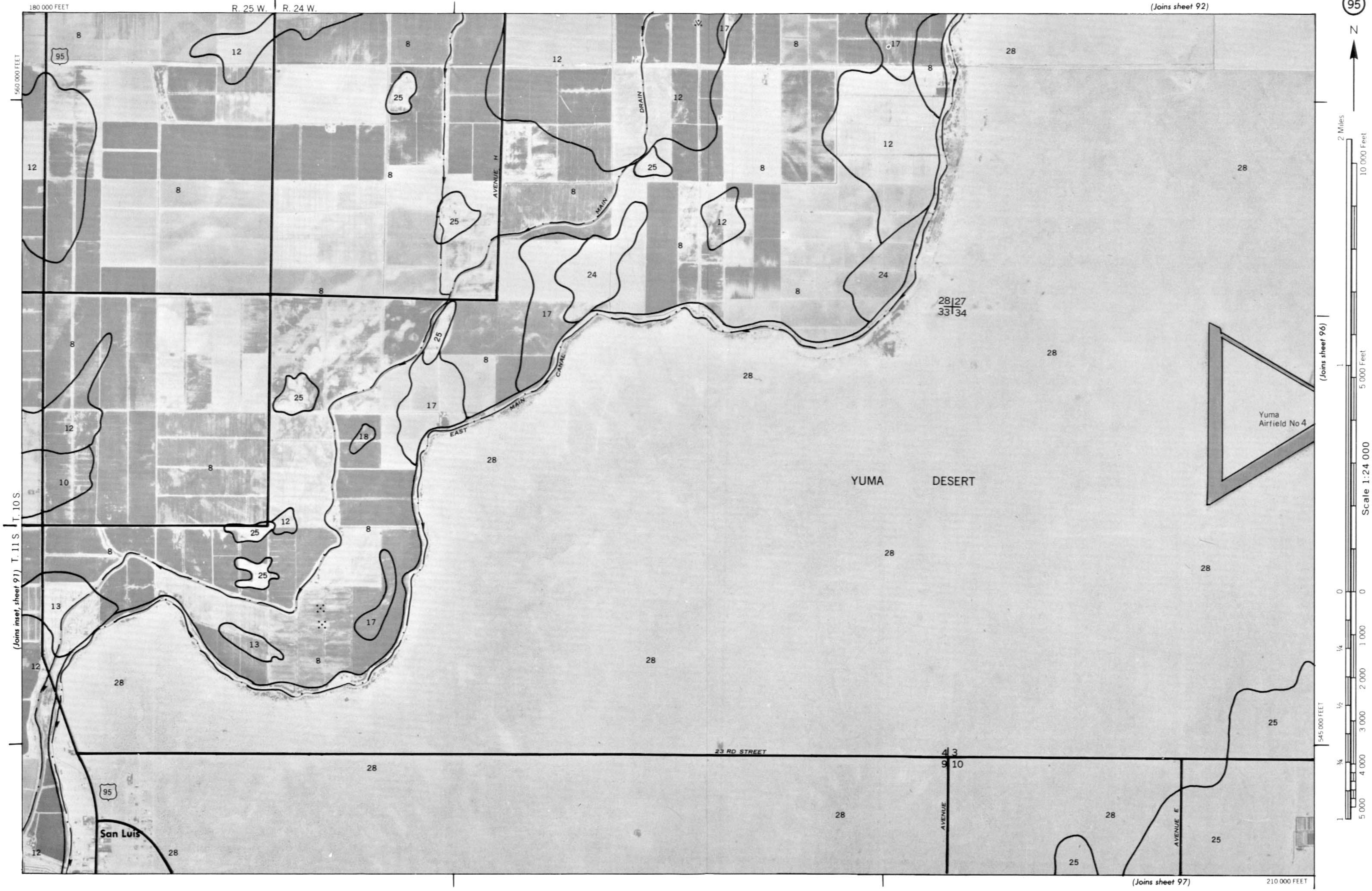
YUMA — WELLTON AREA, ARIZONA — CALIFORNIA, PARTS OF YUMA COUNTY, ARIZONA AND IMPERIAL COUNTY, CALIFORNIA — SHEET NUMBER 92


93
(Joins sheet 84)
(Joins sheet 92)
(Joins sheet 94)
(Joins sheet 96)
R. 24 W.
R. 23 W.
T. 9 S.
T. 10 S.
210 000 FEET
580 000 FEET
565 000 FEET
240 000 FEET
95
COUNTY 17TH STREET
COUNTY 19TH STREET
AVENUE D
AVENUE B
AVENUE A
AVENUE 1E
EAST MAIN CANAL
MAIN LATERAL
COCOPAH INDIAN RESERVATION
N
Scale 1:24 000
2 Miles
10 000 Feet
5 000 Feet
0
1 000
2 000
3 000
4 000
5 000
25
17
12
8
28
29
13

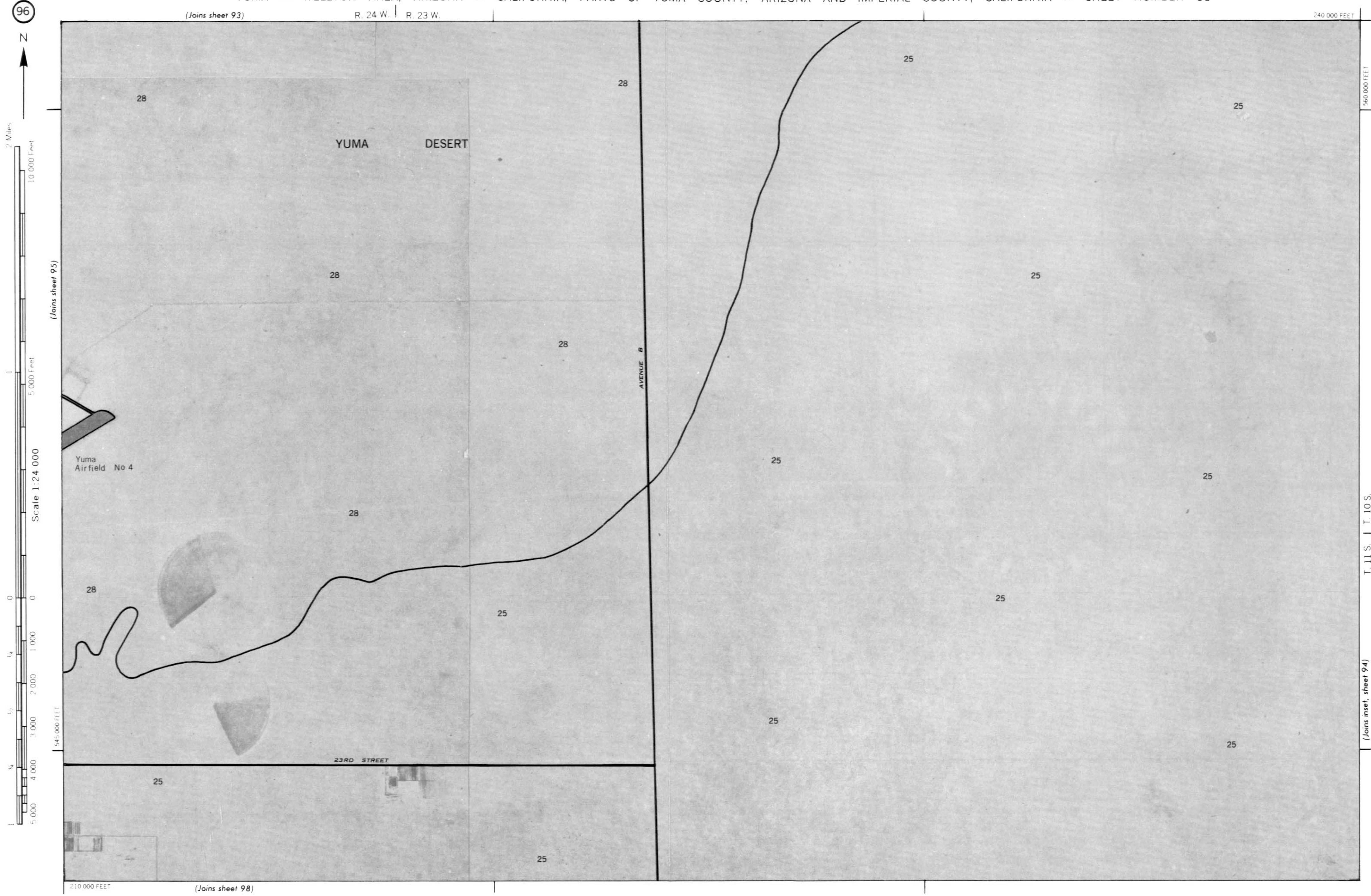
YUMA — WELLTON AREA, ARIZONA — CALIFORNIA, PARTS OF YUMA COUNTY, ARIZONA AND IMPERIAL COUNTY, CALIFORNIA — SHEET NUMBER 94

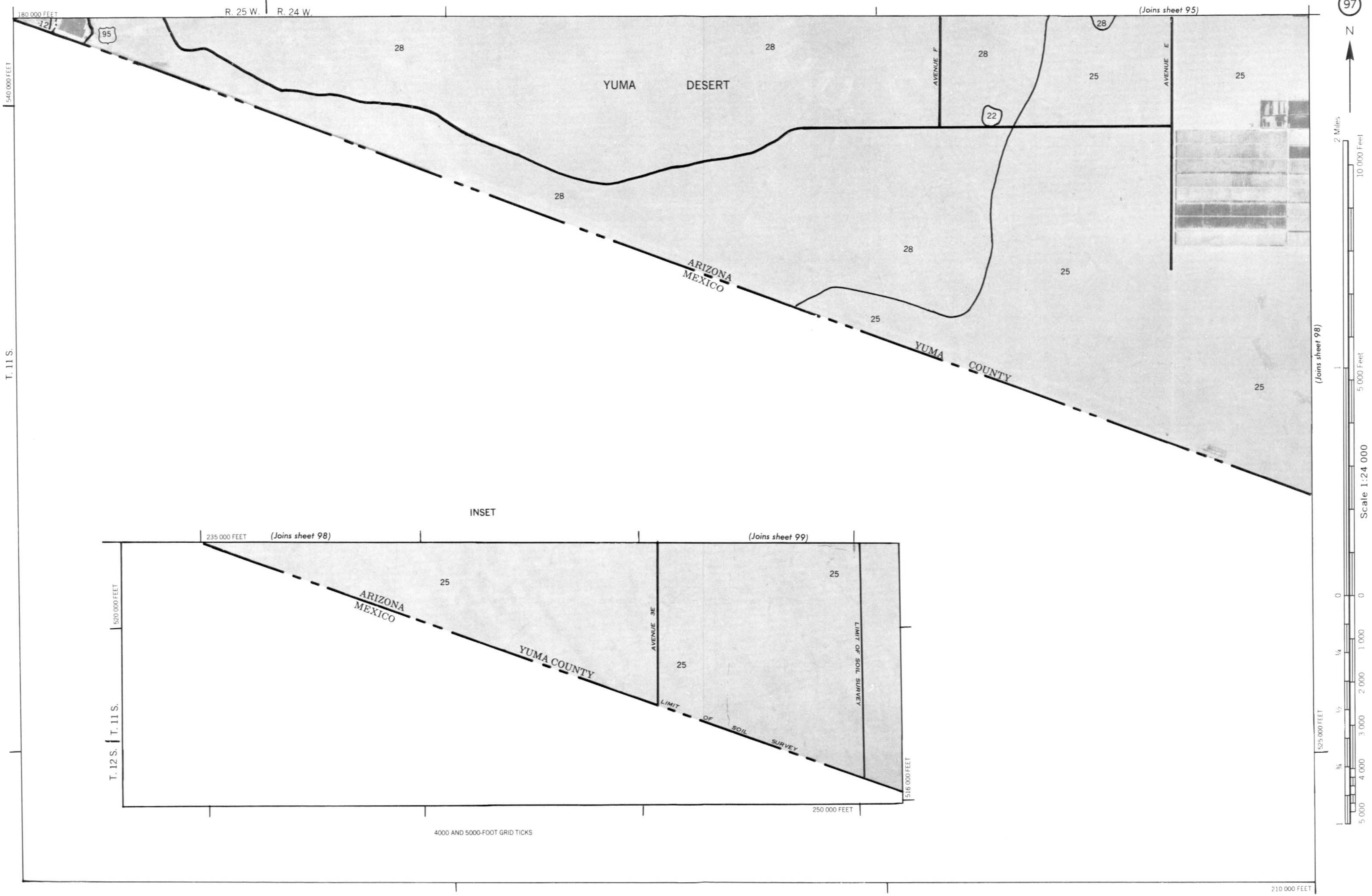


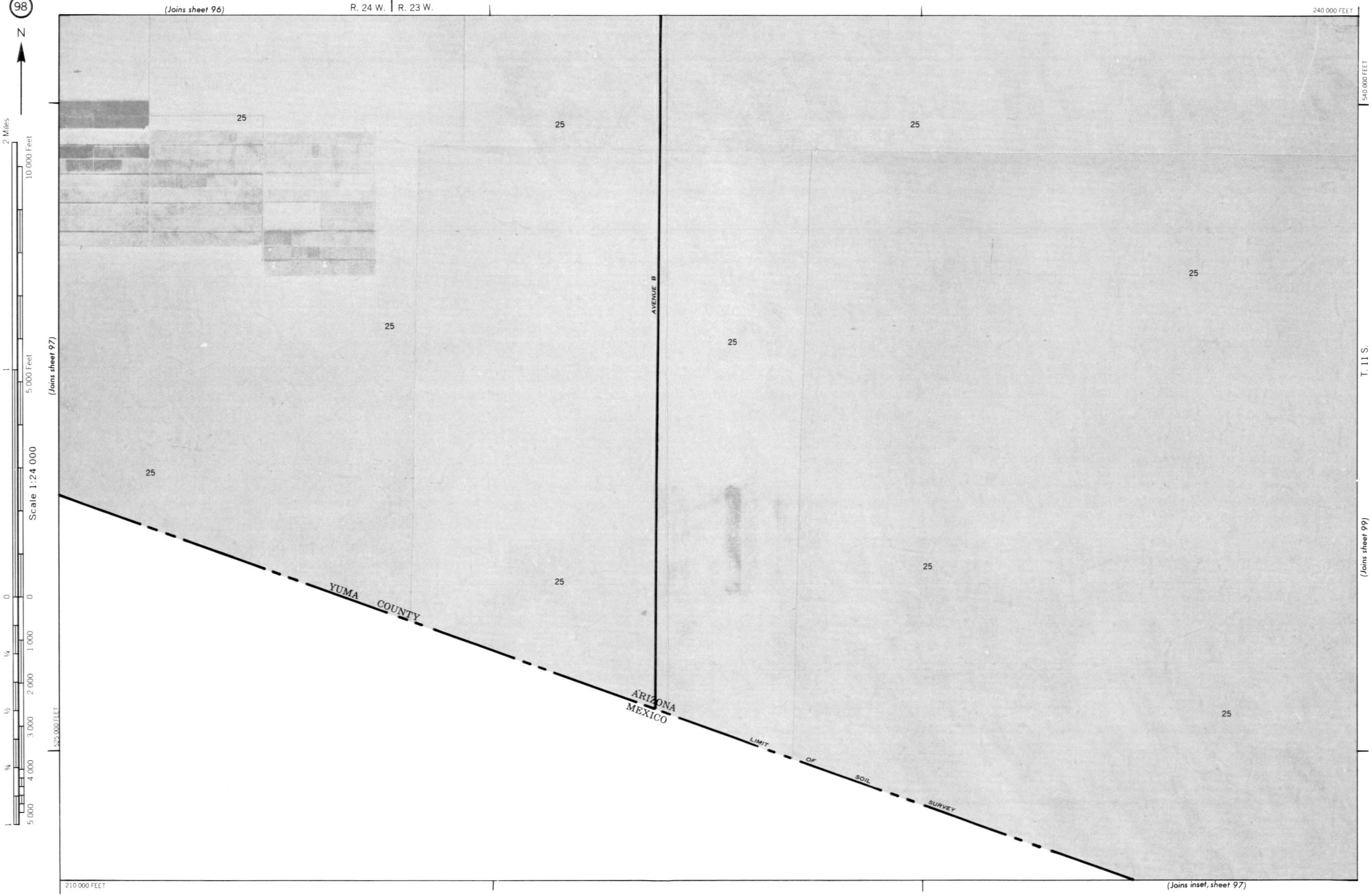


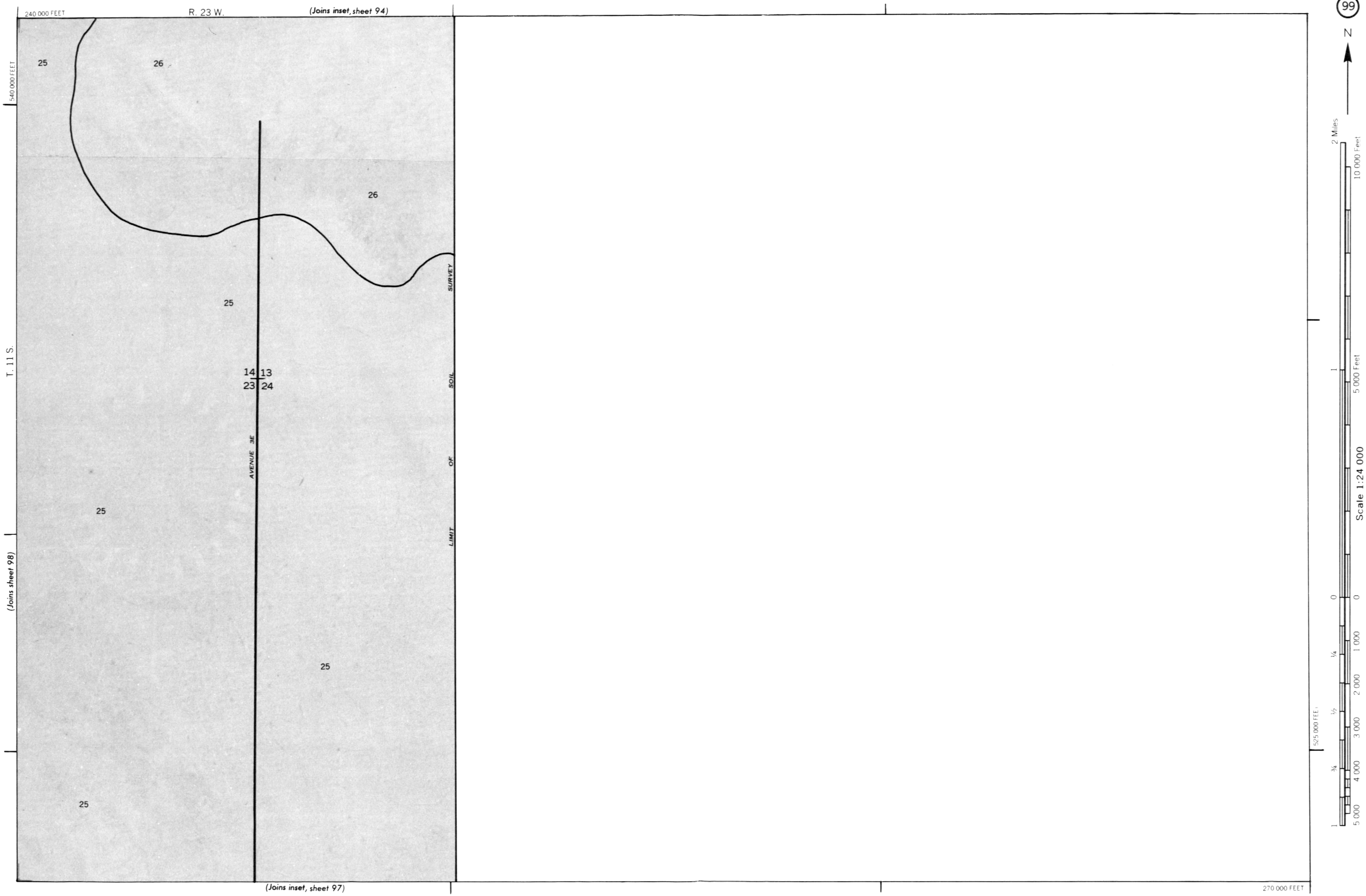


180 000 FEET
R. 25 W.
R. 24 W.
(Joins sheet 92)
95
N
560 000 FEET
T. 10 S.
T. 11 S.
(Joins inset, sheet 91)
(Joins sheet 96)
(Joins sheet 97)
545 000 FEET
210 000 FEET
AVENUE H
DRAIN
MAIN
EAST MAIN CANAL
YUMA DESERT
Yuma Airfield No 4
23 RD STREET
AVENUE
AVENUE E
San Luis
28 27
33 34
4 3
9 10
2 Miles
1
0
10 000 Feet
5 000 Feet
5 000
4 000
3 000
2 000
1 000
Scale 1:24 000


96
N
(Joins sheet 93)
R. 24 W.
R. 23 W.
240 000 FEET
560 000 FEET
(Joins sheet 95)
(Joins inset, sheet 94)
(Joins sheet 98)
210 000 FEET
545 000 FEET
T. 10 S.
T. 11 S.
YUMA DESERT
Yuma Airfield No 4
AVENUE B
23RD STREET
28
25
Scale 1:24 000
2 Miles
1
0
10 000 Feet
5 000 Feet
0
1 000
2 000
3 000
4 000
5 000


97
N
180 000 FEET
R. 25 W.
R. 24 W.
(Joins sheet 95)
540 000 FEET
T. 11 S.
95
12
28
28
28
28
28
28
22
25
25
25
25
25
25
YUMA
DESERT
AVENUE F
AVENUE E
ARIZONA
MEXICO
YUMA
COUNTY
(Joins sheet 98)
INSET
235 000 FEET
(Joins sheet 98)
(Joins sheet 99)
520 000 FEET
25
25
25
ARIZONA
MEXICO
YUMA COUNTY
AVENUE 3E
LIMIT OF SOIL SURVEY
LIMIT OF SOIL SURVEY
T. 12 S.
T. 11 S.
516 000 FEET
250 000 FEET
4000 AND 5000-FOOT GRID TICKS
525 000 FEET
210 000 FEET
2 Miles
1
0
¼
½
¾
10 000 Feet
5 000 Feet
0
1 000
2 000
3 000
4 000
5 000
Scale 1:24 000


98
N
(Joins sheet 96)
R. 24 W.
R. 23 W.
240 000 FEET
540 000 FEET
25
25
25
25
25
25
25
25
25
25
25
AVENUE B
(Joins sheet 97)
(Joins sheet 99)
T. 11 S.
YUMA COUNTY
ARIZONA
MEXICO
LIMIT OF SOIL SURVEY
525 000 FEET
210 000 FEET
(Joins inset, sheet 97)
Scale 1:24 000
2 Miles
10 000 Feet
5 000 Feet
1
0
¼
½
¾
1 000
2 000
3 000
4 000
5 000


99
N
240 000 FEET
R. 23 W.
(Joins inset, sheet 94)
540 000 FEET
25
26
26
25
T. 11 S.
14
13
23
24
AVENUE 3E
LIMIT OF SOIL SURVEY
(Joins sheet 98)
25
25
25
(Joins inset, sheet 97)
525 000 FEET
270 000 FEET
Scale 1:24 000
2 Miles
1
0
¼
½
¾
1
10 000 Feet
5 000 Feet
0
1 000
2 000
3 000
4 000
5 000